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The Mental Health Sequelae of Traumatic Head Injury in South Vietnamese Ex-Political Detainees Who Survived Torture

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Abstract

Little is known about the relationship between traumatic head injury (THI) and psychiatric morbidity in torture survivors. We examine the relationship between THI and depression, PTSD, post-concussive syndrome (PCS), disability and poor health status in Vietnamese ex-political detainees who survived incarceration in Vietnamese re-education camps. A community sample of ex-political detainees (n=337) and a non-THI, non-ex-detainee comparison group (n=82) were surveyed. 78% of the ex-political detainees had experienced THI. 90.6% of the ex-political detainees and 3.6% of the comparison group had experienced 7 or more trauma events. Depression and PTSD were greater in ex-detainees than the comparison group (40.9% vs 23.2% and 13.4% vs 0%). Dose-effect relationships for THI and trauma/torture in the ex-political detainee group were significant. Logistic regression in the pooled sample of ex-detainees and the comparison group confirmed the independent impact of THI from trauma/torture on psychiatric morbidity (OR for

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PTSD=22.4; 95% CI: 3.0-165.8). These results demonstrate important effects of THI on depression and PTSD in Vietnamese ex-detainees who have survived torture.

Keywords

THI; traumatic brain injury; PTSD; depression; Vietnamese; ex-political detainees

Traumatic head injury (THI) is a common form of torture and human degradation that occurs during war and other forms of mass violence. Thygesen, Hermann and Willanger [1] demonstrated significant neurological and psychiatric morbidity in concentration camp survivors associated with the most commonly reported torture, blows and kicks to the head. Clinical studies have documented chronic neuropsychiatric findings in torture survivors including cerebral atrophy. [2] Rasmussen [3] found that 64% (N=200) of torture survivors revealed neurological impairments (2/3 with head injury). Other studies of torture survivors and survivors of mass violence have linked psychiatric symptoms, neurological impairment, and traumatic brain injury (TBI). [4-8]

Very little research has been conducted that establishes the relationship between THI and psychiatric disorders such as depression and posttraumatic stress disorder (PTSD) and related physical disability and health status in tortured persons. [9] A study of refugee survivors of torture with self-reported head injury found an increased risk of negative physical consequences among those with possible TBI. [10] A recent review of the literature in non-torture survivors concluded that there is significant overlap between TBI and PTSD, mild TBI may increase a person's risk for PTSD, and stress reactions following mild TBI rather than any neurological damage itself might be a key contributor to impairment. [11] In a random sample of U.S. Vietnam-era veterans in the community, mild TBI sustained after military discharge was associated with higher rates of headaches, memory and sleep problems and was found to prolong or complicate recovery from pre-existing PTSD. [12] Depression was found to be common in TBI rehabilitation patients aged 16 or older, and to be associated with worsening of quality of life and participation in society. [13] Mild TBI and ongoing stressors increased the risk of developing delayed symptoms of PTSD in a hospitalized sample. [14]

Systematic, well-designed studies of the impact of THI on the physical and mental health of traumatized persons who have experienced extreme violence are urgently needed so that affected individuals can be appropriately identified and treated. [15-16] Manley and Mass [17] call for a broad-based multidisciplinary effort focused on longitudinal investigations of TBI's natural history, the underlying TBI biology and mechanisms, risk factors, and developing effective treatment approaches.

Our group was in an ideal situation to conduct a community study of torture survivors exposed to THI. The Harvard Program in Refugee Trauma (HPRT) has worked with Indochinese survivors of torture and mass violence since 1981. [18] Between July 1990 and 1992, HPRT with its Vietnamese community partner, the Vietnamese American Civic Association (VACA), conducted the first study of Vietnamese ex-political detainees

resettled in the United States. [19] These political prisoners had been severely tortured in Vietnamese re-education camps and subjected to THI. [20-21]

In our present large-scale community study, we describe the prevalence of THI, the relationship between THI and other related forms of psychiatric morbidity, PCS, functional disability, and poor health status in a population that has experienced extreme violence. A dose-effect relationship between THI and trauma/torture events was also examined. We tested our hypothesis that effects of THI in Vietnamese torture survivors would be independent of non-THI trauma/torture events in their relationship to depression and PTSD. We have already reported on the brain structural abnormalities found in a subsample of this study associated with THI. [22] The study conducted by Hoge et al. [23] on the relationship between mild THI to PTSD and depression in Iraqi veterans returning home further supports our tentative hypotheses related to the mental health impact of THI in Vietnamese ex-political detainees.

Methods

Study population and procedures

The study population included a sample of Vietnamese ex-political detainees resettled in the greater Boston area and a comparison group. We conducted a complete census of 419 ex-political detainees and comparison participants that had received services at VACA. Ex-political detainees were only recruited if they came into the United States under the U.S. Department of State's Humanitarian Operations program for resettling Vietnamese ex-political detainees. Participants were randomly ordered prior to being contacted to avoid selection bias.

Additional recruitment procedures included: (1) a “snowball” approach in which current ex-political detainees were asked to pass on recruitment information to friends and acquaintances, (2) VACA counselors contacted past ex-political detainee clients, (3) a public announcement in Vietnamese in the local Vietnamese newspapers, and (4) a flyer/poster in Vietnamese that was distributed to family and friends of potential ex-political detainees at churches and pagodas.

A comparison group was recruited from VACA's client population. Subjects were men greater than 45 years of age with no history of head injury. Based on our pilot study experience, we knew that it would be impossible to find a non-traumatized Vietnamese control group. Exclusion criteria for both groups included institutionalization, hospitalization, and gross medical or neurological disease. Initial recruitment screens were conducted in Vietnamese by trained VACA staff via telephone. Fifteen percent of potential study participants from both cohorts refused to participate or were ineligible.

Interviews took approximately 2 hours and were administered in Vietnamese by VACA's professional staff. All research staff were trained in human subjects protection according to the standardized protocol of the Massachusetts General Hospital. The Human Subjects Review Committee of the Massachusetts General Hospital approved informed consent and

study design. All subjects participated with informed, voluntary, written consent and the research was completed in accordance with the Helsinki Declaration.

Instruments

The survey instrument was expanded and adapted from our pilot study [19] to construct a valid Vietnamese version of the final questionnaire using standard methods of cross-cultural research. [24-25] Data on risk factors, including personal history, military and wartime work experience, re-education camp experience, migration and resettlement experience, stressful life events, trauma, torture, and head injury were collected.

A detailed THI history questionnaire included a checklist of 24 types of THI events including vehicular accident, accidental falls, physical assaults, and combat-related THI. Since self-report of THI is presumptive evidence for TBI, three other TBI events were included in the THI survey which are known to be associated with potential brain injury in torture survivors (i.e., suffocation, drowning and strangulation). [9,26] Each THI event, associated neurological symptoms, and loss of consciousness was assessed: 1) Before the Vietnam War (before 1954); 2) During the Vietnam War (1954-1975); 3) In Re-education Camp (ex-political detainees only); 4) In Vietnam after the war or the re-education camp; and 5) After leaving Vietnam and resettling in the United States.

The trauma history was derived from the Vietnamese version of the Harvard Trauma Questionnaire (HTQ). [27] Measures of cumulative trauma were constructed from responses to questions about trauma events during: 1) the Vietnam War (1954-1975); 2) Re-education Camp (ex-political detainees only); and 3) Other times. Affirmative responses were summed for 40 non-THI trauma events and 27 torture events.

Outcome measures included the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition [28] symptoms of depression and PTSD, functional disability, symptoms of post-concussive syndrome, self-reported general health status, chronic medical condition and physical disabilities.

Psychological symptoms were measured using a 15-item section of the Hopkins Symptom Checklist – 25 (HSCL-25) measuring depressive symptoms [29] and a 16-item section of the HTQ [27] made up of 16 of the 17 diagnostic criteria for PTSD in DMS-IV. Respondents were asked whether they were bothered by each symptom “not at all” (1), “a little” (2), “quite a bit” (3), or “extremely” (4) in the past week. Both instruments have been widely translated and used in a number of studies among diverse cultural groups [30-34] and validated against clinical diagnoses. [27,35-38]

Scale cut-off points for the HSCL-25 and HTQ for depression and PTSD are greater than or equal to 1.75 and 2.50, respectively. [35,38-39]

Functional disability was measured using the six item physical functioning scale of the Medical Outcomes Study 20-Item Short-Form Health Survey (MOS SF-20), which has been tested for its reliability and validity in a large number of disease settings, countries, and languages. [40-42] A World Health Organization (WHO) physical functioning scale, [43] a

measure of perceived energy level, [44] and a measure of self-perceived health [45] and the Medical Outcome Study Short Form (MOS SF-8) were included. [46]

The self-report of general health status used in our multivariate analyses correlated moderately to strongly (0.44 to 0.49) with our WHO survey measures of health status (i.e., health/energy for work, recreation, and education/training). The general health item correlated 0.43 with normed mental health SF-8 and 0.62 with normed physical health SF-8 (norms are with general US population, mean = 50, SD=10).

The self-reported presence of 25 chronic medical conditions (e.g. high blood pressure) and 6 chronic physical disabilities (e.g. blind in 1 or both eyes) were assessed. A six item scale from the MOS SF-20 measured limitations in physical functioning due to health on a 3-point scale (1, limited for more than 3 months; 2, limited for 3 months or less; and 3, not limited at all). The item responses were summed and then transformed linearly to a 0 (poorest physical functioning) through 100 (no limitations in physical functioning) scale.

A dichotomous variable from the 100-point functional impairment scale was created for the logistic regression analysis. The cutoff point of 50 was selected as a conservative estimate of functional disability (lower than the 91.7 used by Stewart et al. [40] which would have classified 86% of our respondents as functionally impaired).

The post-concussive symptom scale (PC Symptom Scale) was adapted from Cicerone and Kalmar. [47] There are 22 items representing four clusters of symptoms, physical (somatic), cognitive, affective, and sensory. We asked how much of the time the symptoms bothered the participants on a 4-point Likert scale (0=not at all, 1=some of the time, 2=most of the time, 3=all of the time) during the last 2 weeks. The median number of symptoms experienced in our sample was 12 (inter-quartile range [IQR]=5-17, maximum=22).

For analysis of post-concussive symptoms, the PC Symptom Scale summed the 22 item scores with the maximum possible score of 66. For the logistic analyses, we considered a participant to have post-concussive syndrome if he scored above the median of all study participants (> 15; in our sample of n=433, the inter-quartile range of the sum of items scored was 6-23 and the maximum score was 55). Scales proved valid, with split-half reliability (Cronbach alpha) on standardized scores of 0.84 (MOS), 0.92 (HSCL for depression), 0.94 (HTQ for PTSD) and 0.95 (PC Symptom Scale for post-concussive symptoms).

Inter-rater reliability was computed for all survey items from the outcome scales in 28 quality control interviews that were conducted in the presence of an independent observer. We found 100% agreement for most items. The simple kappa exceeded 0.91 and the weighted kappa statistic exceeded 0.94 for all items in the depression, HTQ, MOS and post-concussive scales. The kappa for the categorized trauma and torture variables (none, first-4th quartiles) exceeded 0.84 (weighted kappas exceeded 0.90). Kappas for the dichotomized torture and trauma summary scores (none vs. any) exceeded 0.84 for simple and 0.90 for weighted kappas. Kappas for the case definition of depression, PTSD and disability exceeded 0.92.

We considered a participant to be head-injured if they reported at least one head injury during any time period. The total number of different types of THI events were counted for all time periods and each type of THI event was weighted by its actual frequency and the weighted frequencies were then summed up for all time periods. Only the number of different types of non-THI trauma and torture were counted relative to each time period. In spite of our initial screen, some members of the comparison group self-reported head injuries (n=14) and were eliminated as comparison subjects. Neuroimaging results, reported elsewhere, confirmed that participants were classified accurately as head-injured or not. [22]

Statistical Methods

Differences between the ex-political detainees and comparison group were described using chi-square tests, non-parametric Wilcoxon rank sum tests, and t-tests. We analyzed the independent effect of THI on depression and PTSD in ex-political detainees. The ex-political detainees were categorized into groups based on a median split or quartiles according to the frequency of trauma/torture events and THI events. Linear dose-response effects were evaluated using trend analysis of quartiles.

Because all of the Vietnamese subjects studied have been traumatized, we explored whether or not THI increases the risk of poor psychiatric or health outcome independently from trauma and torture experience through a series of multiple logistic regression analyses on the pooled sample, combining all survey respondents. [48] First, we estimated the unadjusted odds ratio of poor psychiatric or health outcome for those head injured versus not head-injured participants. Secondly, we adjusted the odds ratios for marital status (married vs. not), age at interview, years of education received in Vietnam, the number of years in the USA and living situation (alone vs. not). Thirdly, we analyzed the separate impact of head injury versus trauma and torture experience, with a dichotomized indicator of any traumatic event (one covariate representing any torture or trauma experience). Finally, we assessed the effect of the number of types of trauma events, torture events and the number of head injuries, including a single degree of freedom interaction term between any traumatic event and any THI.

All analyses were performed with SAS statistical analysis software, version 8.2 and tests were considered to be significant if $p < 0.05$. [49-50]

Results

A total of 337 Vietnamese ex-political detainees and 82 members of the comparison group aged 45 years of age and older were included in this analysis. Table 1 provides basic characteristics and comparison of both respondent groups. The ex-political detainees were primarily between the ages of 45 and 65, while the comparison subjects were either younger than 55 or older than 65 years of age. Participants in the comparison group had less education; otherwise the basic demographic characteristics were comparable. Depression and PTSD were greater in ex-detainees.

Secondary to the design of the survey, the comparison group had never been in a re-education camp. The ex-political detainees lived an average of 6.5 years in a communist re-

education camp (Table 2). The comparison group had experienced less trauma and torture; some comparison group members reported torture (N=20, 24%) although most reported fewer than 4 events (N=17). A considerable number had been traumatized (N=52; 63%). The common occurrence of trauma and torture related to the Vietnam War found in Vietnamese resettled in the United States is similar to that shown in our previous pilot study. [19] In contrast, nearly all of the ex-political detainees had experienced traumatic events and they reported higher levels of cumulative torture (e.g. N=97, 29%, with more than 10 torture events) and trauma (e.g. N=105, 31%, with more than 15 trauma events).

As per study design, no members of the comparison admitted to THI, while THI among ex-political detainees was common (78%, N=263). This was confirmed by neuroimaging. [22] Consistent with presumptive evidence of TBI, 70% (N=183) of all participants with THI had unconsciousness associated with their THI events.

Table 3 demonstrates the shift from combat related THI during the Vietnam War to beatings to the head and suffocation during the re-education camp experience in the ex-political detainees. There is dramatic fall off in THI events post re-education camps, with vehicle accidents and falls presenting as the most common cause of THI after leaving Vietnam.

Table 4 shows summary data on the types and frequency of THI events for the ex-political detainees across time periods. Combat and human rights violation-related THI were most common with explosion (158; 47%), beatings to the head (68; 20%) and shrapnel head injury (58; 17%), the most common THIs. About one fourth (N=74; 22%) of the ex-political detainees had no THI events. Of those reporting any THI (N=162), 58% had 2 or more events and 26% (n=73) had 3 or more.

Table 5 shows the additive effect of THI events and trauma/torture events on depression and PTSD. Figure 1 reveals the interaction effect between THI events and trauma/torture events on the risks of having psychiatric disorders. Psychiatric disorders were more prevalent and the risk for psychiatric disorders increased more steeply in response to the trauma/torture exposure in the ex-detainees with THI events.

THI events had a dose-response effect on the risks of psychiatric disorders (depression and/or PTSD) even after controlling for trauma/torture events and other potential confounding factors (Figures 2a and 2b). *Post hoc* trend analysis revealed the presence of linear trend for depression (p=0.001) and PTSD (p=0.023). Standard errors (vertical lines) and confidence intervals are significant.

Table 6 reveals the increased psychiatric morbidity associated with ex-political detainees status as compared to comparison subjects.

In order to sort out the independent contribution of THI and trauma/torture in our entire study population of traumatized resettled Vietnamese refugees we pooled the sample of all respondents. [51] Table 7 presents the results for a series of four analyses for each outcome measure, showing the unadjusted and adjusted odds ratios (OR) for association between all respondents with and without THI. The adjusted odds ratios for trauma/torture were highest for PTSD (22.4; 95% CI: 3.0-165.8) and the lowest for number of physical disabilities (1.6;

95% CI: 0.9-2.8). THI respondents had a higher likelihood of being in poor health than non-THI respondents.

There are overlapping items on the PCS, HTQ and HSCL (and these symptom scores are highly correlated), which raised concerns that the PCS may not be distinguishable from depression and anxiety symptoms associated with PTSD. Sensitivity analyses were performed. The association between PCS and THI, controlling for depression and PTSD, were also analyzed with PCS as a continuous measure. The results were consistent. Although there are differences according to the analysis whether we analyze subscale or total post-concussive syndrome (PCS) score, overall, the results are consistent and show higher risk for PCS in THI participants, even after controlling for depression and PTSD. This result is most consistent across our sensitivity analyses for the somatic and cognitive subscales but also holds for the sensory subscales in the additive indicator logistic regression.

Discussion

This study confirms that THI are commonly reported in South Vietnamese ex-political detainees who survived torture in communist re-education camps and that THI is highly associated with major mental health sequelae including depression and posttraumatic stress disorder. [19,22,52-54] This data supports the brutal and graphic description of Vietnamese ex-political detainees of their re-education camp torture experience and supports the idea that THI as a human rights violation can be embedded within a scenario of multiple trauma and torture events of all types and is not a single isolated event. [55]

As Goldfield et al. [26] suggested as early as 1988, THI is a common form of torture whose presence and related health consequences must be considered in all persons who have been subjected to human rights violations. The effects of THI on psychiatric outcomes in populations that have lived through extreme violence have not been firmly established since the pioneering studies of concentration camp survivors resettled in Norway after World War II that found mechanical impairments, toxic and traumatized brains, and cerebral organic changes. [6,56-58] In a large random sample of Cambodian refugees, Mollica et al. [9] found that THI explained 20% of the variance in symptom scores for depression and 8% for PTSD, respectively.

Our study adds new insight into the THI/trauma/torture relationship. Survey results reveal that THI is synergistic with trauma/torture events in ex-political detainees illustrating that as the number of trauma/torture events increase concurrently with increases in THI events, the presence of depression and PTSD also increases. While this dose-effect relationship has been previously demonstrated in traumatized refugee populations for trauma and torture, this study illustrates the important contribution of THI. [59] THI is demonstrated in the ex-political detainees, as well as in the pooled sample of detainees and the comparison group, to have a major impact on mental health outcomes independent of the effects of trauma and torture events. The pooled sample analysis also revealed the impact on indices of health and disability.

The higher prevalence of PTSD in the THI ex-political detainee group as compared to the non-THI ex-political detainee group and the comparison group is especially important to note. The relatively low rate of PTSD in our comparison group is consistent with the low risk of past-year mental illness found in a population based study of trauma-exposed Vietnamese refugees resettled for ten years in Australia. [60] Those exposed to more than three traumas were at greater risk, however, compared to those who had not been exposed to traumatic events. [60] The recent debate that PTSD may not be occurring due to loss of consciousness in THI survivors may not be a relevant issue in those individuals who have experienced THI and loss of consciousness during episodes of extreme violence that include multiple traumatic life events. [61-63] The high co-morbidity of depression with PTSD and post-concussive syndrome in THI respondents is some indication of the severity of THI-related psychiatric illness. Our study clearly indicates that in traumatized groups who have experienced extreme violence and torture, the presence of PTSD might be masking an underlying traumatic brain injury secondary to THI, especially as PTSD in this study has been shown to be an independent result of THI, when all other non-THI trauma and torture events are controlled for. In particular, PTSD might be a specific marker for THI, and quite possibly TBI. Our neuroimaging study of this population further addresses this issue, and documents the association between structural brain abnormalities in Vietnamese ex-political detainees with THI and symptom severity of depression. [22] This is consistent with other studies in non-torture survivors. THI in non-traumatized populations is associated with brain structural abnormalities in the pre-frontal temporal cortices. [64] These areas of the brain are known to be associated with regulation of mood, affect, and the processing of traumatic memories.

Our results are consistent with mental health findings in mainstream non-traumatized general populations. [47,65-72] Similarly, in studies of combat veterans, THI is associated with PTSD, [73] depression, [74] and health problems. [23] THI also appears to increase the risk of post-concussive syndrome (PCS) and poor health status. While the symptoms of PCS are highly correlated with PTSD and depression, our analysis reveals that PCS, like PTSD, is also independently associated with THI. The potential health risks for THI survivors are far-reaching. Our study reveals increased risk for disability, self-perception of poor health status, and increased number of medical and physical illnesses in THI survivors, consistent with the literature. [75] PCS and poor health status may be partially mediated through chronic depression and PTSD. [23,76-80] Some combat veteran researchers, however, claim that THI events are not unique but are similar to other types of trauma that cause PTSD and mediate mental health outcomes through stress responses in contrast to direct brain changes. [11,81] Our current data and neuroimaging results do not support this viewpoint. Our results suggest that it would be clinically remiss not to consider THI-related neurological and cognitive changes in persons who have a history of extreme violence, and therefore possible THI. [22,82] In any event, a history of THI and the possibility of TBI in a torture survivor must be considered and identified using neuropsychiatric testing and neuroimaging. [82] Determining underlying brain disease will lead to more effective evidence-based treatment. [83-84] THI survivors and their family members must receive education regarding the cause of the patient's symptoms and the rationale for TBI treatment since they are most likely

unaware of the clinical importance of THI [82,85] and given the enormous psychological and other stress faced by caregivers of those with TBI. [86-87]

Limitations

A cross-sectional retrospective study such as ours cannot establish causal mechanisms between THI and psychiatric morbidity. It is our hypothesis, supported by our results, that THI mediated brain injuries contribute to the development of PTSD and depression as suggested in the model by Flannelly, Koenig, Galek, and Ellison. [88] Kay, Newman, Cavallo, Ezrachi, and Resnick [89] provide a clear exposition of the possible neuropsychological processes by which mild THI can lead to negative mental health outcomes. Our neuroimaging studies of a random sample of ex-detainees and comparison subjects published elsewhere strongly support the role of the prefrontal temporal lobes, damaged in THI, being linked to PTSD and depression. [22] Our results also show that associations between THI, post-concussive syndrome (PCS), disability and poor health status exist. These relationships, however, are poorly understood and require considerable research attention including a prospective long-term follow-up of THI damaged torture survivors.

Another limitation of the study is the possibility that the Vietnamese ex-political detainees surveyed were a biased sample. There may be something special about the nature of the THI they suffered that is accounting for our results. Few ex-political detainees had THI without multiple traumas, therefore we studied dose-effect and controlled for trauma/torture events. THI events had an independent relationship to mental health outcomes.

The Vietnamese comparison group was selected to be as similar to the ex-political detainees as possible except for the absence of THI. It is almost impossible to find Vietnamese men resettled in the USA who have not had traumatic life experiences before arriving in America, [19] so we adjusted for this by comparing detainees to a non-THI comparison group and secondly by pooling all participants, estimating the effects of THI after controlling for torture and trauma experience. [51]

Determining the relative severity of events in populations who have experienced extreme and multiple traumas is difficult using self-report. Twenty-five years of research conducted by our Harvard research team and others have shown the validity of measuring the self-reports of extreme trauma and torture events. When we developed the HTQ, we decided to limit respondent distress by including only those trauma and torture events that would beyond doubt have a major psychological impact on the victim/survivor. [38] Hatch and Dohrenwend [90] support this view, stating, “simple recall over long periods of time is not feasible for all but major traumatic and other large stressful events” (p. 329).

The issue of recall biases related to THI and other trauma/torture events has been a perceived limitation of all studies using retrospective memories of traumatic life events. [91-93] We have addressed this recall biases critique in our longitudinal study of Bosnian refugees using measurements that were also applied in this study [94] and suspect that there was an underreporting of all events over-time.

The self-reporting of THI in our survey may be inaccurate. [72] Amnesia associated with THI may be contributing to poor memory of THI events. Amnesia is not pathognomonic of mild THI and it is hard to imagine a scenario in which so many individuals falsely report THI at various times in their past. Objective history of the nature and severity of the THI events and possible TBI sequelae does not exist since Vietnamese re-education camps did not keep records on the health status of their inmates and the medical records of the South Vietnamese Army were also not available. Our THI-affected survey respondents gave histories of head injury events commonly associated with loss of consciousness that suggest the possibility of TBI. [95-97] These events were independently associated with brain changes on our neuroimaging study, [22] helping to validate the accuracy of self-reporting in our survey groups by providing an independent and objective measure of THI and trauma/torture.

Conclusion

For the first time since the original work of Eitinger [56-57] immediately after World War II, THI and presumptive TBI (objectively presented in our neuroimaging study [22]) have been demonstrated to be strongly related to psychiatric morbidity, disability, and poor health status in survivors of extreme violence. THI events such as “beatings to the head” are unfortunately common instruments of human cruelty. The brain is an extremely sensitive organ that can be readily damaged without obvious indications of a penetrating wound or major neurological deficit. [64] These invisible wounds, however, can have major emotional, social, and health consequences over time. Screening for and the treatment of THI health and mental health sequelae must become standard operating practice in the care of those individuals affected by mass violence and torture.

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Box 1

Definitions of Key Terms

Traumatic Head Injury (THI) ^a	Concussion-associated THI, with 1 or more occasions during which all 3 postconcussive symptoms (loss of consciousness, posttraumatic transient amnesia, and any neurologic deficits) occurred.
Traumatic Brain Injury (TBI) ^b	TBI entails damage to the brain resulting from an external force (e.g., brain laceration, intracranial hematoma, intracranial hypertension, hypoxia, anemia, contusion, metabolic anomalies, shearing of the fibers of nerves, and contrecoup injuries). It is not due to a degenerative or congenital insult to the brain. It may lead to temporary or permanent impairment of cognitive, physical, and psychosocial functions, with associated altered or reduced state of consciousness.
Post Concussive Syndrome (PCS) ^b	A syndrome that includes fatigue, sensitivity to light or sound, headache, dizziness, sleep disturbance, and concentration problems. The symptoms of PCS overlap with some of the symptoms of PTSD.

Notes: Definitions vary from source to source.

^aDefinition is from Mollica RF, Lyoo IK, Chernoff MC, Bui HX, Lavelle J, Yoon SJ, et al. Brain structural abnormalities and mental health sequelae in South Vietnamese ex-political detainees who survived traumatic head injury and torture. *Arch Gen Psychiatry*. 2009;66(11):1221-1232.

^bDefinition is from Bryant R. Posttraumatic stress disorder vs. traumatic brain injury. *Dialogues in Clinical Neuroscience*. 2011;13(3):251-262.

Box 2**What is a dose effect relationship?**

A dose-effect relationship is “a relationship in which a change in the amount, intensity, or duration of exposure is associated with a change in risk of a specified outcome” (Farlex, 2012). In the present study, we tested our hypothesis that effects of THI in Vietnamese torture survivors would be independent of non THI trauma/torture events in their relationship to depression and PTSD.

Source: Farlex (2012). Farlex Partner Medical Dictionary. Retrieved from <http://medical-dictionary.thefreedictionary.com/dose-response+relationship>

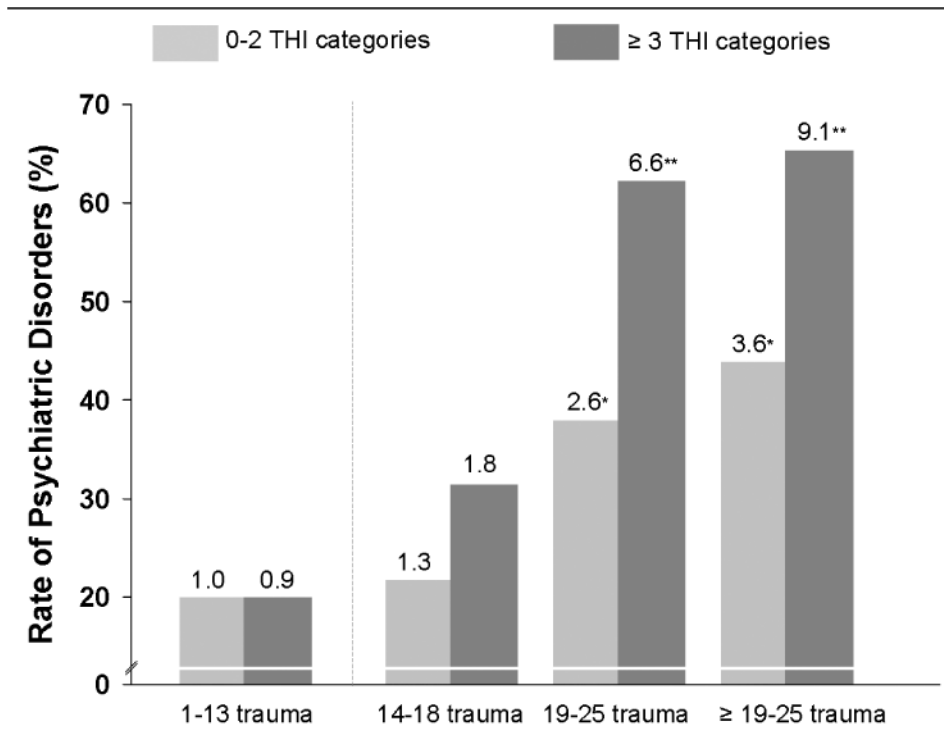


Figure 1. Frequency of Traumatic Head Injury Events and Trauma/Torture Events Associated with Psychiatric Disorders

Abbreviation: THI, traumatic head injury.

Cases with any missing items on trauma and torture evaluation were excluded.

Traumatic head injury events, which include both the type and frequency information, were categorized into two groups of bites. Trauma/torture events were categorized into quartiles. Subjects of no trauma exposure were excluded in producing PTSD odds ratio.

Adjustment was performed using multiple logistic regression with covariates for marital status (married vs. not married), age at interview, education in Vietnam, current living status (with spouse or children vs. other situations) and years in USA.

Associated increases in risk of depression are shown at the top of each vertical bar.

* p<0.05, ** p<0.001.

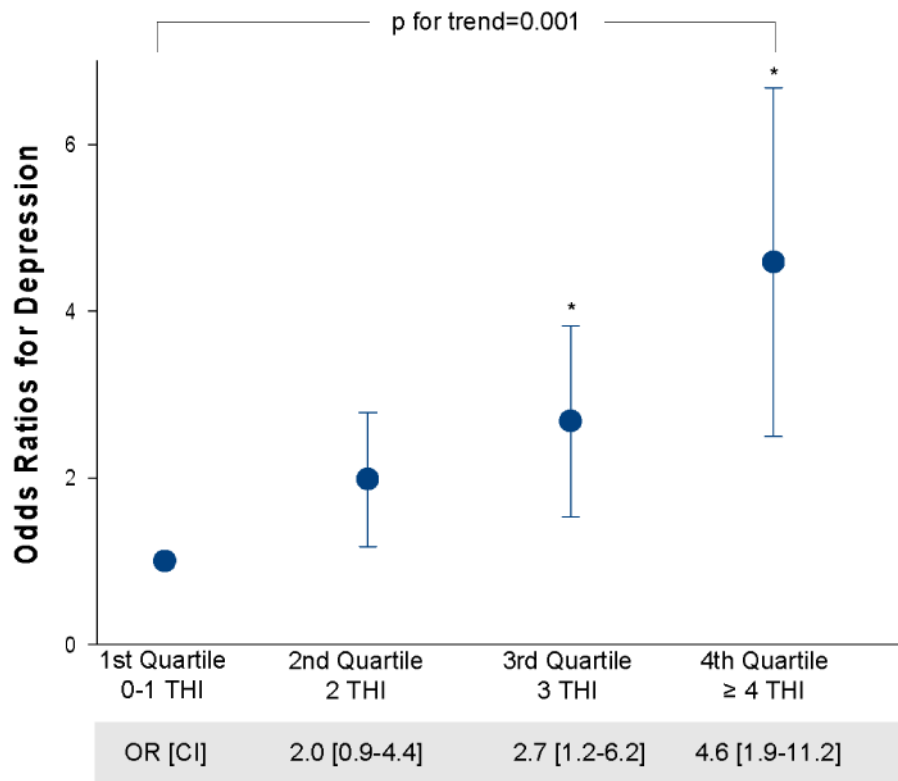


Figure 2a. Odds Ratio for Depression in South Vietnamese Ex-Political Detainees
 Error bars indicate standard error.
 Cases with any missing items on trauma and torture evaluation were excluded

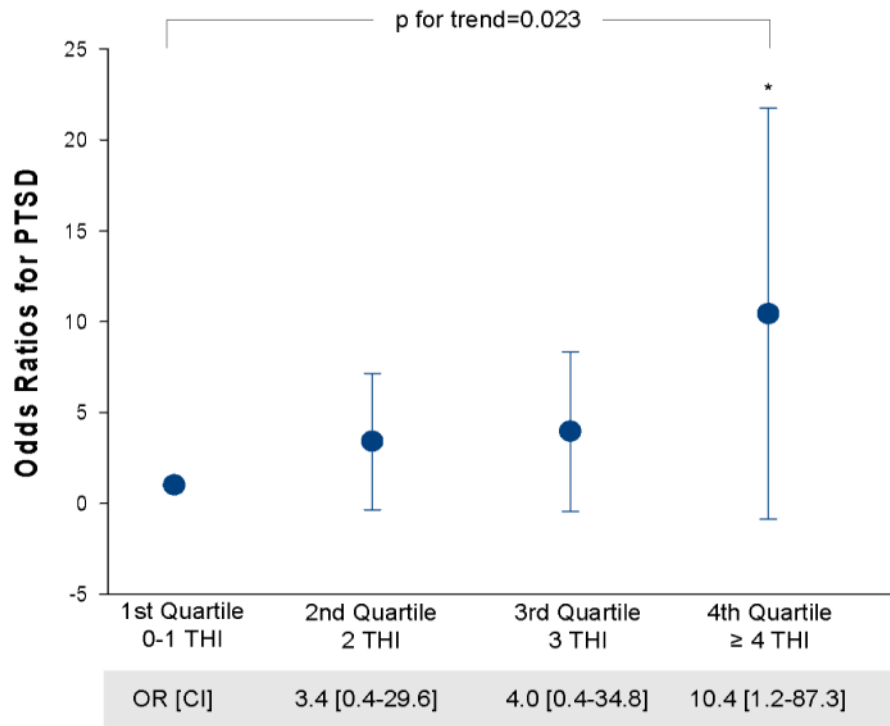


Figure 2b. Odds Ratio for Posttraumatic Stress Disorder (PTSD) in South Vietnamese Ex-Political Detainees

Error bars indicate standard error.

Cases with any missing items on trauma and torture evaluation were excluded.

Table 1
Demographic Characteristics of Survey Respondents: Vietnamese Comparison Group and Ex-Political Detainees

Characteristic	Comparison Group (N = 82)		Detainees (N = 337)		P-value
Gender – Male – N (%)	82	(100)	337	(100)	n/a
Age, y – Mean (SD)	62.4	(11.2)	60.5	(7.4)	0.16 [‡]
45-55	26	31.7%	80	23.7%	0.21 [‡]
>55-60	9	11.0%	107	31.8%	
>60-65	12	14.6%	72	21.4%	
>65	35	42.7%	78	23.1%	
Years in USA – Mean (SD)	11.6	(8.0)	9.5	(4.3)	0.02 ^{*‡}
Citizenship					
No	39	47.6%	79	23.4%	<0.001 [*]
Yes	43	52.4%	258	76.6%	
Marital Status					
Currently Married	62	75.6%	269	79.8%	0.01 [*]
Separated, Divorced	8	9.8%	45	13.4%	
Widowed	4	4.9%	16	4.7%	
Never Married	8	9.8%	7	2.1%	
Religion					
Buddhist	50	61.0%	191	56.7%	0.25
Christian	18	22.0%	103	30.6%	
Other	14	17.0%	43	12.8%	
Living Alone					
No	71	86.6%	293	86.9%	0.93
Yes	11	13.4%	44	13.1%	
Education (y)					
1-8	39	47.6%	46	13.6%	<0.001 ^{*‡}
9-12	34	41.5%	226	67.1%	
13	9	11.0%	65	19.3%	
Someone to rely on for support in USA⁺					

Characteristic	Comparison Group (N = 82)		Detainees (N = 337)		P-value
No	19	23.2%	76	22.7%	0.93
Yes	63	76.8%	259	77.3%	
English Language Ability					
Moderately or Very Well	30	36.6%	154	45.7%	0.14
Little or Not at all	52	63.4%	183	54.3%	
Currently Employed					
No	55	67.1%	248	73.6%	0.24
Yes	27	32.9%	89	26.4%	
Employed in last years (current or past)					
No	38	46.3%	197	58.5%	0.05
Yes	44	53.7%	140	41.5%	
Prevalence of Depression & PTSD					
Depression					
No	63	76.8%	199	59.1%	0.003*
Yes	19	23.2%	138	40.9%	
PTSD					
No	82	100%	292	86.6%	<0.001***
Yes	0	0%	45	13.4%	

[†] 2-sided Wilcoxon rank-sum test (normal approximation)

[‡] 2-sided Student's t-test (unequal variances)

* p < 0.05,

** p < 0.001

⁺ 2 ex - detainees with missing data

Unless indicated, p-values were for Pearson Chi Square test.

Table 2
Trauma, Torture and Head Injury Characteristics of Survey Respondents: Vietnamese Comparison Group and Ex-Political Detainees

Characteristic	Comparison Group (N = 82)	Detainees (N = 337)	P-value
<i>Time in re-education camp (years)</i>			
Mean (SD) ^a	0	6.5 (3.6)	n/a
Median (IQ Range)	0	6.4 (4.9, 8.1)	n/a
<i>Number of torture events</i>			
Median (IQ Range)	0 (0, 0)	7 (5, 11)	
0 torture events	62	3	0.9% <0.001 †
1-3 torture events	17	37	11.0%
4-6 torture events	3	109	32.3%
7-10 torture events	0	91	27.0%
More than 10 torture events	0	97	28.8%
<i>Number of Trauma Events</i>			
Median (IQ Range)	1 (0, 3)	13 (10, 16)	
0 trauma events	30	1	0.3% <0.001 †
1-6 trauma events	49	31	9.2%
7-11 trauma events	2	104	30.9%
12-15 trauma events	1	96	28.5%
More than 15 trauma events	0	105	31.2%
<i>Any head injury</i>			
No	82	74	22.0% <0.001*
Yes	0	263	78.0%
<i>Any loss of consciousness associated with head injury</i>			
	n/a	N=263 ^b	
No		79	30.2% n/a
Yes		183	69.8%

Notes:

^a 95% CI for mean years in camp is: 6.1, 6.9

^b 1 participant had unknown LOC value.

* $p < 0.05$

[†] 2-sided Wilcoxon rank-sum test (normal approximation)

Unless indicated, p-values were for Pearson Chi Square test.

Table 3
Head Injury Experiences of the Vietnamese Ex-Political Detainees by time period (N=337)

	During War (1954-1975)			Re-Education			In VN after War or after Re-Education			After Leaving VN		
	N	%		N	%		N	%		N	%	
Explosion	154	45.7	Beaten on head	56	16.6	Fall for other reason	7	2.1	Hit head against dash	14	4.2	
Shrapnel	58	17.2	Near Suffocation	43	12.8	Beaten on head	4	1.2	Fall for other reason	12	3.6	
Fall from vehicle	35	10.4	Fall from fatigue	28	8.3	Fall from vehicle	3	0.9	Whiplash*	7	2.1	
Fall for other reason	21	6.2	Fall for other reason*	14	4.2	Unexplained fainting, LOC+*	2	0.6	Fall from fatigue	7	2.1	
Beaten on head	9	2.7	Fainting, LOC*+	12	3.6	Fall from fatigue	2	0.6	Unexplained fainting, LOC*+	7	2.1	
Shot in head	7	2.1	Work accident	12	3.6	Near Suffocation	2	0.6	Beaten on head	3	0.9	
Hit head on dash	6	1.8	Explosion	4	1.2				Work accident	3	0.9	
Near drowning	5	1.5	Hit on head during escape	2	0.6				Fall from vehicle	2	0.6	
Near strangulation	3	0.9	Near strangulation	2	0.6				Near suffocation	2	0.6	
Near Suffocation	2	0.6	Near drowning	2	0.6							

Also 1 each: Hit by vehicle; whiplash*, fall from fatigue; other head injury

Also 1 each: Hit head against dash, Other head injury, Drowning.

Also 1 each: Hit by vehicle, Other head injury, Near strangulation

Note: There were reports of 10 events during the period prior to 1954; Falls for other reasons (4); Other head injury (2); Drowning (2); Fall out of vehicle (1); Unexplained fainting or LOC (1).

Note:

* 1-3 missing values not counted in denominator

Note:

+ Unexplained fainting or LOC was not counted as head injury event in analysis

Table 4
The Number and Percent of Vietnamese Ex-Political Detainees Reporting Each Type of Head Injury Across Time

Type of Head Injury	Ex-Political Detainees (N=337)	
	N	%
Explosion	158	46.88
Beaten on head	68	20.18
Shrapnel	58	17.21
Fall for other reason	55	16.32
Suffocation	47	13.95
Fall out of vehicle	40	11.87
Fall from fatigue	36	10.68
Hit head against dashboard	19	5.64
Work accident	15	4.45
Drowning	9	2.67
Whiplash	9	2.67
Shot in head	7	2.08
Strangulation	6	1.78
Other head injury	5	1.48
Hit by vehicle	3	0.89
Hit head while trying to escape from camp	2	0.59

Table 5
Additive Effects of Trauma/Torture Events and Traumatic Head Injury events on Depression and PTSD in Ex-Political Detainees

Symptom Class	Depression				PTSD			
	N	Number (%) Defined as Case	Odds Ratio (95% CI) ^a	Number (%) Defined as cases	N	Number (%) Defined as cases	Odds ratio (95% CI) ^a	
Traumatic Head Injury Events								
0-2 THI	170	46 (27.1%)	1.0	166 ^b	8 (4.82%)	1.0		
3 THI	167	92 (55.1%)	3.35 (2.09 to 5.35) ^d	167	37 (22.16%)	3.35 (2.09 to 5.35) ^d		
Other Trauma/Torture Events								
0-13 trauma/torture events	75	15 (20.0%)	1.0	73 ^b	0 (0%)	NA		
14-18 trauma/torture events	81	21 (25.9%)	1.51 (0.69 to 3.33)	81	2 (2.47%)	1.0		
19-25 trauma/torture events	74	37 (50.0%)	4.25 (1.98 to 9.10) ^d	74	11 (14.86%)	7.59 (1.54 to 37.35) ^c		
26 trauma/torture events	88	54 (61.4%)	7.70 (3.61 to 16.4) ^d	88	29 (32.95%)	24.90 (5.18 to 119.84) ^d		
Interaction between Trauma/Torture and Traumatic Head Injury Events								
0-2 THI (1-13 trauma/torture)	65	13 (20.0%)	1.0	63	0 (0%)	NA		
0-2 THI (14-18 trauma/torture)	46	10 (21.7%)	1.28 (0.49 to 3.38)	46	0 (0%)	NA		
0-2 THI (19-25 trauma/torture)	37	14 (37.9%)	2.56 (1.00 to 6.56) ^c	37	3 (8.1%)	1.0		
0-2 THI (>26 trauma/torture)	16	7 (43.8%)	3.59 (1.07 to 12.06) ^c	16	5 (31.3%)	6.48 (1.26 to 33.18) ^c		
3 THI (1-13 trauma/torture)	10	2 (20.0%)	0.91 (0.16 to 5.25)	10	0 (0%)	NA		
3 THI (14-18 trauma/torture)	35	11 (31.4%)	1.83 (0.68 to 4.89)	35	2 (5.7%)	0.56 (0.083 to 3.80)		
3 THI (19-25 trauma/torture)	37	23 (62.2%)	6.85 (2.68 to 17.49) ^d	37	8 (21.6%)	3.18 (0.75 to 13.39)		
3 THI (>26 trauma/torture)	72	47 (65.3%)	9.06 (3.98 to 21.62) ^d	72	24 (33.3%)	6.48 (1.75 to 24.03) ^c		

Abbreviations: PTSD, posttraumatic stress disorder; CI, confidence interval; NA, not applicable.

^a Adjustment was performed using multiple logistic regression with covariates for marital status (married vs. not married), age at interview, education in Vietnam, current living status (with spouse or children vs. other situations), and years in USA.

^b Subjects of no trauma exposure were excluded in producing PTSD odds ratio.

^c $p < 0.05$.

^d $p < 0.001$.

Cases with any missing items on trauma and torture evaluation were excluded.

Table 6
Psychiatric and Health Status of Vietnamese Comparison Group and Ex-Political Detainees

	Comparison Group (N=82)		Ex-Detainees (N=337)		p-value
	N	%	N	%	
Depression					
No	63	76.8%	199	59.1%	0.003*
Yes	19	23.2%	138	40.9%	
PTSD					
No	82	100%	292	86.6%	<0.001 ψ^*
Yes	0	0	45	13.4%	
Disability					
No	52	63.4%	169	50.2%	0.03
Yes	30	36.6%	168	49.8%	
Post-concussive Syndrome					
No	68	82.9%	154	45.7%	<0.001*
Yes	14	17.1%	183	54.3%	
General Health Status, past 4 weeks					
Excellent, Good	21	25.6%	42	12.5%	0.002 [†]
Fair	38	46.3%	157	46.6%	
Poor, Very Poor	23	28.1%	138	40.9%	
Number of Chronic Medical Conditions					
0 to 2	62	75.6%	156	46.3%	<0.001*
3 or more	20	24.4%	181	53.7%	
Number of Physical Disabilities					
None	19	23.2%	61	18.1%	0.29
One or more	63	76.8%	276	81.9%	

ψ^* Fisher's Exact Test

^f 2-sided Wilcoxon rank-sum test

Unless indicated, p-values were for Pearson Chi Square test.

Table 7

Odds Ratios for the association between psychiatric disorders, disability, post-concussive syndrome and health outcomes in THI vs. non-THI respondents based upon univariable and multivariable logistic regression models.

	Total		Head Injured Status				Relative probability of outcome for head injured vs. uninjured			Relative probability of outcome for each additional reported head injury	
	N	%	No head injuries (N=156)		1 or more head injury (N=277)		Unadjusted	Adjusted ^a	Adjusted for torture and trauma ^b		
			N	%	N	%					
Depression											
No	271	62.58%	126	80.76%	145	52.34%	1.0	1.0	1.0	1.0	1.0
Yes	162	37.41%	30	19.23%	132	47.65%	3.8 (2.4,6.1)*	3.3 (2.1,5.4)*	3.1 (1.9, 5.2)*	1.7 (1.3,2.3)*	1.7 (1.3,2.3)*
PTSD											
No	388	89.60%	155	99.35%	233	84.11%	1.0	1.0	1.0	1.0	1.0
Yes	45	10.39%	1	0.64%	44	15.88%	29.3 (4.0,214.7)*	26.4 (3.6, 195.5)*	22.4 (3.0, 165.8)*	1.5 (1.1,2.1)*	1.5 (1.1,2.1)*
Disability											
No	227	52.42%	97	62.17%	130	46.93%	1.0	1.0	1.0	1.0	1.0
Yes	206	47.57%	59	37.82%	147	53.06%	1.9 (1.2,2.8)*	2.2 (1.4,3.4)*	2.2 (1.3,3.5)*	1.4 (1.1,1.8)*	1.4 (1.1,1.8)*
Post-concussive Syndrome											
No	229	52.88%	126	80.76%	103	37.18%	1.0	1.0	1.0	1.0	1.0
Yes	204	47.11%	30	19.23%	174	62.81%	7.1 (4.4, 11.3)*	6.7 (4.1,10.8)*	5.9 (3.9,8.9)*	1.7 (1.2,2.3)*	1.7 (1.2,2.3)*
General health status during the past 4 weeks[†]											
excellent to good	63	14.54%	36	23.07%	27	9.74%	1.0	1.0	1.0	1.0	1.0
Fair	199	45.95%	76	48.71%	123	44.40%	1.0	1.0	1.0	1.0	1.0
poor, very poor	171	39.49%	44	28.20%	127	45.84%	2.2 (1.4,3.3)*	2.2 (1.4,3.5)*	2.1 (1.3, 3.4)*	1.3 (1.0,1.6)*	1.3 (1.0,1.6)*
Number of chronic med conditions											
0 to 2 (median)	227	52.42%	117	75.00%	110	39.71%	1.0	1.0	1.0	1.0	1.0

	Head Injured Status				Relative probability of outcome for head injured vs. uninjured				Relative probability of outcome for each additional reported head injury	
	No head injuries (N=156)		1 or more head injury (N=277)		Odds Ratio (95% CL)					
	N	%	N	%	Unadjusted	Adjusted ^a	Adjusted for torture and trauma ^b	Adjusted, with continuous head injury, torture, trauma covariates ^c		
3 or more	206	47.57%	39	25.00%	167	60.28%	4.6 (2.9,7.0)*	5.0 (3.1,8.0)*	4.9 (3.0, 8.1)*	1.4 (1.1,1.9)*
Number of physical disabilities										
None	81	18.70%	37	23.71%	44	15.88%	1.0	1.0	1.0	1.0
One or more	352	81.29%	119	76.28%	233	84.11%	1.6 (1.01,2.7)*	1.5 (0.9,2.5)	1.6 (0.9,2.8)	1.1 (0.8,1.5)

Note:

* p < 0.05

[†] Odds computed as probability of poor health status to fair, good or excellent.

Note:

^a Adjustment was performed using multiple logistic regression with covariates for marital status (married vs. not married), age at interview, education in VN, current living status (with spouse or children vs. other situations), yrs in USA, head injury status.

^b These analyses adjusted for covariates noted in (a). In addition, they included one covariate representing any traumatic experience (trauma or torture experience). For PTSD we only included participants who had experienced at least some torture or trauma (excluding 32 participants who reported no torture or trauma). For the other outcomes, we excluded 3 participants with head injury but no torture or trauma and report results for the additive models because it was then not possible computationally to include the interaction. When interaction effects were first included in the analyses of the full dataset for depression, PCS, general health status and chronic medical conditions, they were non-statistically significant.

^c The final set of models adjusted for covariates noted in (a) and also for the number of trauma, torture and head injury events. They also included the single degree of freedom interaction effect between head injury and any traumatic experience, represented by a 0/1 indicator covariate. The odds ratios for THI represent increased risk with each additional reported event.

Traumatic Head Injury (THI) ^a	Concussion-associated THI, with 1 or more occasions during which all 3 postconcussive symptoms (loss of consciousness, posttraumatic transient amnesia, and any neurologic deficits) occurred.
Traumatic Brain Injury (TBI) ^b	TBI entails damage to the brain resulting from an external force (e.g., brain laceration, intracranial hematoma, intracranial hypertension, hypoxia, anemia, contusion, metabolic anomalies, shearing of the fibers of nerves, and contrecoup injuries). It is not due to a degenerative or congenital insult to the brain. It may lead to temporary or permanent impairment of cognitive, physical, and psychosocial functions, with associated altered or reduced state of consciousness.
Post Concussive Syndrome (PCS) ^b	A syndrome that includes fatigue, sensitivity to light or sound, headache, dizziness, sleep disturbance, and concentration problems. The symptoms of PCS overlap with some of the symptoms of PTSD.

Notes: Definitions vary from source to source.

^aDefinition is from Mollica RF, Lyoo IK, Chernoff MC, Bui HX, Lavelle J, Yoon SJ, et al. Brain structural abnormalities and mental health sequelae in South Vietnamese ex-political detainees who survived traumatic head injury and torture. *Arch Gen Psychiatry*. 2009;66(11):1221-1232.

^bDefinition is from Bryant R. Posttraumatic stress disorder vs. traumatic brain injury. *Dialogues in Clinical Neuroscience*. 2011;13(3):251-262.