Comorbidity of Mild TBI and PTSD in OIF/OEF Veterans: A Review

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ABSTRACT: Technological advances in military protective gear have allowed soldiers who fought in Iraq and Afghanistan to survive head injuries that may have proved fatal in prior conflicts. These veterans often obtain traumatic brain injuries (TBIs), the majority of which are diagnosed as mild (mTBI). However, Post-Traumatic Stress Disorder (PTSD) has been found to often be comorbid with mTBI in veterans; the combination of these two diagnoses can prolong psychological and physical symptomology, which could have implications for treatment. This review aims to consolidate evidence pertaining to the comorbidity of mTBI and PTSD diagnoses in Operation Iraqi Freedom (OIF) and Operation Enduring Freedom (OEF) veterans. This evidence includes: the long-term impact these diagnoses have on veterans' cognition, experience of post-concussive symptoms, overall levels of disability, and diagnosis of other mental health issues.

Background

In military conflicts, American soldiers face a unique set of obstacles not often faced by their civilian counterparts. Two key challenges experienced by military personnel during and post-deployment include diagnoses of traumatic brain injuries (TBIs) and Post-Traumatic Stress Disorder (PTSD). The symptoms resulting from these diagnoses have been experienced by soldiers throughout history, but have received increased attention from the scientific community in recent years.

According to the Department of Defense (2017), American soldiers obtained a total of 370,688 TBIs from 2000 to 2017. Of those TBIs, 82.3% of were diagnosed as mild traumatic brain injuries (mTBIs), which can include symptoms such as confusion, disorientation, memory loss for less than 24 hours, and loss of consciousness for up to 30 minutes (Department of Defense, 2017). Fortunately, symptoms from mTBIs tend to clear up on their own within three months of the injury (Terrio et al., 2009). However, this is not the case for everyone. In fact, Terrio and colleagues (2009) found that in one Army unit that fought in Iraq, 7.5% of soldiers who were diagnosed with a TBI reported experiencing symptoms after returning home from deployment. Another estimate claims that most military personnel with mTBIs experience residual symptoms for 18 to 24 months after the injury (National Center for PTSD, 2007).

In one study of a military unit deployed to Iraq, 22.8% of soldiers were diagnosed by a clinician as having a TBI during their year-long deployment, and most of these were diagnosed as mTBIs (Terrio et al., 2009). Of the TBIs sustained by the unit, 88% were caused by exposure to a blast explosion, while the rest involved head injury from impacts unrelated to blast exposure (Terrio et al., 2009). This evidence supports a common finding that of the TBIs sustained by military personnel in recent conflicts, most are caused by exposure to blasts.

There are four types of blast TBIs military populations may sustain in combat (Lawhorne & Cheryl, 2010; Gondusky & Reiter, 2005; Meyer, Maerion, Coronel, & Jaffee, 2010). These injuries include being exposed to a pressure wave (primary blast injury), brain penetration from an explosive projectile (secondary blast injury), flying into a solid surface due to the force of a blast (tertiary blast injury), and extreme loss of blood or exposure to toxic gases released in an explosion (quaternary blast injury) (Lawhorne & Cheryl, 2010; Gondusky & Reiter, 2005; Meyer et al., 2010). According to Lawhorne and Cheryl (2010), quaternary blast injuries are rare, and the number of secondary blast injuries has decreased in recent wars due to advances in technology in military protective gear. However, primary and tertiary blast injuries have increased in frequency during the recent conflicts in Iraq and Afghanistan (Lawhorne & Cheryl, 2010). Primary, secondary, tertiary, and quaternary blast injuries may occur individually when a soldier experiences blast exposure. However, it is more likely that military personnel experience multiple forms of blast injury in a given explosion, making it difficult to attribute post-concussive symptoms (PCSs) to a particular injury type.

Additionally, mTBI diagnoses are often further complicated by a diagnosis of PTSD. PTSD is a mental health disorder resulting from exposure to one or more traumas, including combat situations. This diagnosis is characterized by four symptom clusters. These symptom categories include re-experiencing symptoms, avoiding situations that remind one of the traumatic event, negative changes in beliefs and feelings, and hyperarousal (National Institute of Mental Health, 2016). Estimates of PTSD prevalence in OIF/OEF veterans range from 10-30% (Hoge et al., 2004; National Center for PTSD, 2007). The variability in these estimates is due to factors such as the number of firefights the sampled soldiers were in (Hoge et al., 2004), whether they were deployed to Iraq or Afghanistan (Hoge et al., 2004), and whether or not the soldier obtained an injury during deployment (Hoge et al., 2004; French, 2010). Additionally, many veterans may not seek help for PTSD symptoms, due to stigma or fear of appearing weak, making the prevalence difficult to solidify.

Far from being new phenomenon, occurrences of PTSD and mTBIs have been recorded throughout U.S. military history (French, 2010). PTSD symptoms were referred to as "nostalgia" or "soldier's heart" during the Civil War, "shell shock" in World War I, and "battle fatigue" or "Combat Stress Reaction" in World War II (National Center for PTSD, 2007). Additionally, the impact of TBIs were studied in World War I, World War II, and the Vietnam War (French, 2010). Penetrating brain injuries were the most studied in these conflicts due to their high prevalence and provided researchers with valuable information on brain function. In the aftermath of the recent conflicts in Afghanistan and Iraq, however, increased attention is being paid to closed brain injuries, especially mTBIs. This is because the technology of military gear has minimized the occurrence of penetrating TBIs, and has increased the likelihood of military personnel surviving head injuries (Gondusky & Reiter, 2005; Meyer et al., 2010). Despite this progress, there was a larger proportion of head injuries sustained in OIF/OEF veterans than in any previous wars (Gondusky & Reiter, 2005). The percentage of head wounds in military personnel was 21% in WWII, 21.4% in the Korean War, 16% in the Vietnam War, and 30% in OIF/OEF veterans (Owens et al., 2008). According to Owens and colleagues (2008), 79% of the head wounds in OIF/OEF soldiers were obtained from explosions, which is the highest prevalence in any large-scale combat effort.

Given the increase in head wounds in recent conflicts, and increasing use of explosive devices in combat, it is critical to analyze the impact these issues have on U.S. military personnel. Complicating the study of mTBIs and PTSD, however, is the overlap in symptomology in diagnoses; these symptoms include irritability, memory issues, fatigue, dizziness, headache, sensitivity to noise and light, difficulty concentrating, depression, and anxiety (Lawhorne & Cheryl, 2010; Bhattacharjee, 2008). These shared symptoms make PTSD and mTBI diagnoses highly comorbid. Stein and McAllister (2009) found that not only are mTBIs more likely to co-occur with PTSD than to be a singular diagnosis, but PTSD symptomology may be more severe in those who also have an mTBI compared to other forms of injury. In fact, having a combat-related mTBI could increase a soldier's likelihood of developing PTSD by 300% (Lippa et al., 2015). Further illustrating this finding, Hoge and colleagues (2008) found that 43.9% of OIF/OEF veterans, who experienced loss of consciousness, and 27.3% of those who reported alterations in consciousness, from mTBIs sustained in combat, met criteria for PTSD.

PTSD and mTBI symptoms can be problematic for veterans even after returning from deployment. In OIF/OEF veterans, it's estimated that 20% have received a TBI diagnosis, and yet only 40% of those diagnosed patients are thought to have received medical care (Lawhorne & Cheryl, 2010). This discrepancy may be due to natural healing over time. However, Terrio et al. (2009) found that 7.5% of soldiers who experienced a mTBI during deployment reported struggling with three or more PCSs after returning home. This illustrates the need for medical care access for veterans experiencing mTBI symptoms post-deployment. Additionally, it's been reported that despite the high prevalence of mental health diagnoses such as PTSD in OIF/OEF veterans, only 23-40% of them have sought mental health treatment (Hoge et al., 2004). It is critical to assess the impact PTSD and mTBI symptoms have on OIF/OEF veteran functioning in order to better address their medical and mental health care needs.

Impact on Veteran Functioning Attention and Cognition

Blast mTBIs

Research is beginning to be published on the impact of mTBIs on OIF/OEF veterans' cognitive and attentional functioning. The focus has centered on blast mTBIs specifically due to their increasing prevalence in recent conflicts. For example, Trudeau and colleagues (1998) found that blast mTBIs resulted in problems with impulsivity, lowered attentional capacity, and increased hyperactivity in veterans. The military personnel in this study reported that these attentional deficits impeded their ability to function normally in daily tasks (Trudeau et al., 1998). Along with attentional capacity, cognitive functioning has also been shown to be damaged in military personnel who obtained blast mTBIs. For example, Mac Donald et al. (2015) found that during the week following acquisition of the blast mTBI, participants did worse on tasks involving mathematical processing, reaction time, code substitution learning, and sample matching tasks than they had done before deployment. These soldiers were followed-up with 6-12 months after returning from deployment, and it was found that cognitive and executive functions remained more impaired in subjects that had experienced a blast mTBI than in soldiers who had not obtained a mTBI (Mac Donald et al., 2015).

Comorbid mTBI and PTSD

Analyses have also been conducted on how the interaction of PTSD and mTBI may further impact attention and cognition in OIF/OEF veterans. For instance, Lange and colleagues (2016) found that one year after returning from deployment, veterans with comorbid PTSD and mTBI performed worse on measures of attention, short-term memory, long-term memory, verbal fluency, mental processing speed, and executive functioning than veterans with a mTBI but no PTSD diagnosis. Another study found that veterans with comorbid PTSD and mTBI performed worse on neuropsychological assessment tasks than veterans with a mTBI only, and attributed this difference to reduced processing speed and response inhibition in the group with both diagnoses (Nelson, Yoash-Gantz, Pickett, & Campbell, 2009). However, Nelson et al. (2009) did not find differences in cognitive flexibility between the tested groups. These findings illustrate the impact that mTBIs and comorbid PTSD have on the cognitive and attentional abilities of OIF/OEF veterans.

Post-Concussive Symptoms (PCSs)

Along with attentional and cognitive impairment, OIF/OEF veterans with a mTBI diagnosis may struggle with PCSs. Immediate symptoms following mTBI acquisition have been reported retrospectively by military personnel to include headache, dizziness, balance problems, irritability, and memory deficits (Terrio et al., 2009). Unfortunately, these symptoms have been found to linger in most veterans who've obtained a mTBI in combat (National Center for PTSD, 2007). In samples assessed 3-4 months (Hoge et al., 2008) and 6-12 months (Mac Donald et al., 2015) after deployment, it was found that soldiers who obtained a blast mTBI experienced increased severity, frequency, and overall severity in headaches compared to veterans without a mTBI. However, Lippa, Pastorek, Benge, and Thornton (2010) believe PCS severity may be better accounted for by PTSD symptomology than mTBI diagnosis alone. These researchers discovered that in a sample of veterans with mTBIs, increased PTSD symptomology resulted in more PCSs being endorsed by the participant (Lippa et al., 2010). These findings illustrate how mTBI and PTSD comorbidity can impact aspects of OIF/OEF veteran well-being, including their experience of PCSs post-deployment.

Overall Disability

Along with attentional and cognitive deficits, and increased levels of PCSs, veterans with comorbid mTBI and PTSD experience higher rates of overall disability than veterans without these diagnoses (Hoge et al., 2008; Stojanoic, 2016; Mac Donald et al., 2015; Lange et al., 2016; Lippa et al., 2015). Addressing overall levels of disability, Mac Donald and colleagues (2015) found that 63% of participants who had experienced a blast mTBI had moderate overall disability a year after the injury, compared to 20% of veterans that hadn't been diagnosed with PTSD or a mTBI (Mac Donald et al., 2015). Lippa et al. (2015) and Lange et al. (2016) took a more general approach to assessing overall disability in veterans, relying on self-reported quality of life. These researchers determined that veterans who have a mTBI with comorbid PTSD report having a lower quality of life than veterans without these diagnoses (Lippa et al., 2015; Lange et al., 2016). Although these researchers used a broad and subjective form of measurement, these findings are important to ascertain veteran perceptions on overall functioning. Hoge and colleagues (2008) took a more detailed approach, assessing specific factors related to veteran health. Through the study, it was found that veterans with comorbid mTBI and PTSD had more medical visits, missed work days, and experienced overall poorer health than veterans without these diagnoses (Hoge et al., 2008). Also addressing disability levels through health measures, Stojanovic et al. (2016) assert that veterans with PTSD and mTBIs self-report higher levels of overall pain intensity than veterans without one or both of these diagnoses. These studies reflect the severe effect comorbid mTBI and PTSD can have on veterans' ability to function in their lives after serving in combat.

Interaction with Other Mental Health Issues

Alcohol Abuse

Findings for alcohol abuse in OIF/OEF veterans with mTBIs and PTSD has been mixed. Overall, it has been found that veterans tend to misuse alcohol more when they return from deployment than before they are deployed (Hoge et al., 2004). However, Meyer et al. (2010) claim that for veterans with mTBIs, alcohol use tends to decrease after injury. Additionally, alcohol use does not seem to be different in veterans with blast mTBIs and veterans without blast mTBIs (Meyer et al., 2010).

Contradicting the findings for mTBIs, PTSD has been found to be associated with alcohol abuse. According to the National Center for PTSD (2007), veterans with PTSD are more likely to abuse alcohol and binge drink than veterans without PTSD. It is critical that drinking habits be assessed when diagnosing PTSD, as veterans with this diagnosis who abuse alcohol are more likely to commit suicide than veterans with PTSD that do not abuse alcohol (National Center for PTSD, 2007). No information was found regarding alcohol misuse in veterans with both mTBIs and PTSD diagnoses. Given the negative impact alcohol can have on veteran health, it is critical that research be conducted on whether or not alcohol abuse exacerbates symptoms of comorbid mTBI and PTSD, and that alcohol use be taken into account during treatment of veterans with these diagnoses.

Depressive Disorders

Overall, it has been found that depressive disorders are more prevalent in soldiers after deployment than before deployment (Hoge et al., 2004). Depressive disorders also tend to be highly comorbid with mTBIs and PTSD. According to Mac Donald et al. (2015), depressive symptomology tends to be higher in military personnel with mTBIs than in those without mTBIs in the week following injury as well as 6-12 months later. In fact, Lippa et al. (2015) found that depressive disorders were 140% more likely to be diagnosed in veterans with mTBIs than in veterans without mTBIs. As for PTSD, it is estimated that 3-25% of OIF/OEF veterans with this diagnosis are likely to have also developed

Major Depressive Disorder since deployment (National Center for PTSD, 2007). These findings indicate the need to assess for depressive symptomology when diagnosing mTBIs and PTSD in military personnel, as it may have important influence on veterans' well-being.

Implications for Treatment

Due to the attentional and cognitive deficits, PCSs, overall disability, and additional mental health problems faced by veterans with mTBIs and PTSD, it is important for healthcare providers to take a multidisciplinary approach to treatment (Hoge et al., 2008). However, it can be difficult for the approximately 27.9% of OIF/OEF veterans with mental disorders (French, 2010) to seek care. One cause of this could be lack of awareness of mTBI and PTSD symptomology in veterans and their families (Meyer et al., 2010). Another barrier to treatment could be fear of stigma. According to Hoge and colleagues (2004), soldiers who reported struggling with mental health post-deployment were twice as likely to express concern over experiencing stigma if they were to get help than soldiers who reported no mental health issues. Due to these barriers to treatment, it is critical that open discussions are had with veterans and their families regarding mTBI and PTSD symptomology and available treatment options. This allows for greater identification of symptoms the veterans may struggle with, and reduces the stigma and fear surrounding getting help.

General Discussion

Despite the long history of mTBIs and PTSD obtained in combat, analyzing the impact the comorbidity of these diagnoses has on veterans is a relatively new field of study. Current scientific findings are also not without flaws. To begin with, participants in studies of military personnel are mostly white males, which limits generalizability to female and minority veteran populations. There can also be issues with diagnosing veterans in military studies. For example, most mTBI diagnoses are not often diagnosed in combat zones, making most diagnoses retrospective and based on self-report. This can be problematic due to poor recollection of the injuring event from loss or alteration of consciousness following a mTBI. Combat zones are often chaotic, making it unlikely that another person could accurately observe the injured soldier's symptoms following injury and thus increase the accuracy of a diagnosis. Soldiers also may not seek treatment while in the field due to safety reasons or feeling as if their injuries are less severe than those sustained by their comrades. Another issue with recent studies of mTBI and PTSD in veterans is researchers compare those with a given diagnoses to those without, as there is little baseline data on the soldiers. Although attempts are made to control for differences in variables such as age and education between groups, it would be more accurate to compare veteran functioning to an established personal baseline. Finally, many studies only analyze the impact of mTBI and PTSD on veterans for up to a year after they return from combat. Neurodegeneration takes time, and one year may not be long enough for the resulting symptomology to appear. Therefore, these studies may not be capturing the long-term impacts of mTBI and PTSD as they so claim.

Although some flaws in current studies of mTBI and PTSD in military personnel may be difficult to overcome, there are steps that can be taken to minimize these issues and improve future studies. For example, baseline data could be collected on soldiers before they are deployed, allowing for utilization of a stronger within-subjects design. By comparing a veteran's post-deployment and pre-deployment data, it would increase the likelihood that changes between time points would be due to experiences the veteran obtained in combat. Additionally, participants should include greater diversity for increased generalizability of findings. Longitudinal follow-ups with veterans diagnosed with mTBIs and PTSD are also important, as they allow for detection of future alterations in functioning that may indicate further neurodegeneration. Finally, it is critical that future studies utilize scientifically valid assessment measures for diagnosis in veterans. Currently, some researchers are developing their own assessment tools, which have not been proven to be reliable or valid. In order to gather accurate data on mTBIs and PTSD, empirically based measurements must be used. By incorporating these improvements to future study designs, the impact of comorbid mTBI and PTSD on veteran functioning can be more accurately determined.

Throughout history, soldiers have endured symptoms that are now known to be related to diagnoses such as mTBI and PTSD. The recent conflicts in Iraq and Afghanistan have led to more American military personnel meeting criteria for these diagnoses due to the increased survival rate of those experiencing head trauma. Veterans with symptoms from these diagnoses can face extreme mental, emotional, and physical distress making it difficult for them to reintegrate into their civilian lives. Therefore, it is imperative that research continue on the impact mTBIs and comorbid PTSD have on OIF/OEF veterans' cognition, experience of post-concussive symptoms, overall levels of disability, and diagnosis of other mental health issues. By studying these diagnoses, better treatment plans can be developed to assist U.S. veterans and improve their quality of life.

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