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Introduction

- Following deployment, many Defence personnel return with physical and psychiatric symptoms, with a comorbid presentation often seen.
- Of particular concern is the 'signature injury' for the recent wars in Iraq (OIF) and Afghanistan (OEF); that being mild traumatic brain injury (mTBI; Scheibel, Newsome, Troyanskaya, Lin, Steinberg, Radaideh & Levin, 2012; Vasterling, Verfaellie & Sullivan, 2009) and how this may relate to the onset or maintenance of posttraumatic stress symptoms and substance misuse.
- Prevalence estimates for mTBI in those returning from OEF/OIF vary from 4.2% to 23% (US and UK forces).
- Research to date suggests that psychiatric illnesses such as posttraumatic stress disorder (PTSD) and major depressive disorder (MDD) are more prevalent in those who sustain a mTBI, although the mechanism for this is still unknown (Matthews, Spadoni, Lohr, Strigo & Simmons, 2012).
- There is a need to effectively detect and treat those who have sustained a mTBI and who are also experiencing posttraumatic stress symptoms and/or substance use problems.
- It is unclear if standard treatments for posttraumatic stress and substance misuse (namely, exposure-based and cognitive-behaviour therapies) are suitable for those with mTBI.
- Further, it is unclear if those exposed to blast explosion may sustain damage to brain regions that increase vulnerability to developing posttraumatic stress symptoms and/or substance misuse.

Aim

- This review aims to provide greater insight into the impact of mTBIs among Defence personnel.
- Specifically, we will identify the neurological patterns of mTBI, PTSS and substance misuse through the use of functional magnetic resonance imaging (fMRI) and/or diffusion tensor imaging (DTI).
- The neurological, neuropsychological and psychological factors, all of which are important for determining appropriate treatment will be reported for mTBI, PTSS and substance misuse separately and then this information will be collated to determine any neurological similarities and differences.
- Further information regarding the impact such neurological factors have on treatment for trauma symptoms will also be explored.



Method

- The authors have begun to systematically review publications in PubMed, PsycInfo and Embass.
- Search terms include: "military", "defence", "magnetic resonance", "diffusion tensor", "imaging", "substances", "alcohol", "marijuana", "cannabis", "illicit", "cocaine", "amphetamine", "stimulant", "traumatic brain injury", "TBI", "trauma", "post-traumatic stress" and "PTSD".
- Articles have been removed that do not present magnetic resonance imaging (MRI), functional magnetic resonance imaging (fMRI) or diffusion tensor imaging (DTI) as the imaging outcome, do not report whole brain analyses, do not include a veteran or active military population, do not include those with either a mild traumatic brain injury or those with posttraumatic stress disorder, articles not published in peer-review articles, articles presented at conferences or commentary based articles.
- Data to be collected and collated: mTBI cause, time since injury, mTBI diagnosis criteria, posttraumatic stress symptoms, brain regions of interest for mTBI, blast and PTSD, summaries.
- Data will be presented in 4 arms: Trauma imaging, Mild TBI imaging, Substance misuse and all.



Preliminary Results

- Trauma: 1355 results
- Mild TBI: 334 results
- Substance misuse: 1343 results
- All (trauma, mTBI and substance misuse): 34 results
- TBI group initial findings using Diffusion Tensor Imaging:
 - 11 articles met criteria for whole brain DTI analyses in military personnel with a mTBI
 - Neurological changes were reported in all 11 studies.
 - Loss of white matter integrity (reduced fractional anisotropy) was seen in both major fibre bundles and smaller peripheral tracts.
 - Number of white matter potholes was associated with a history of loss of consciousness and duration of post-traumatic amnesia.
 - Evidence of multifocal white matter abnormalities.
- PTSD: reported in 3 of the 11 studies.
 - Study 1: PTSD severity was related to underlying structural changes on DTI
 - Study 2: No significant differences in fractional anisotropy (FA; DTI outcome for white matter integrity) between those with and without PTSD
 - Study 3: Loss of white matter integrity was not associated with PTSD

Conclusion

- The review is ongoing with only the mild traumatic brain injury results reviewed. Despite this, the initial results strongly suggest that neurological damage can occur in those who sustain mild TBIs or sub-concussive injuries. Such neurological damage may pertain to the genesis or maintenance of psychological symptoms however this relationship is inconclusive.
- Attempts to identify neurological damage sustained following blast-related mTBI is crucial due to the high number of returning defence personnel reporting blast exposure and ongoing post-concussion and psychiatric symptoms.
- Despite evidence of underlying neurological damage in some, results have not been consistent nor has methodology in the studies reviewed thus far.
- Many factors have been shown to be important when imaging work is being undertaken with blast-related mTBI such as time and diagnostic criteria.
- Complex processes relating to damage and repair following mTBI reveal the critical importance of time. Studies have suggested that abnormalities evident through DTI may normalise with time. This prevents comparison of DTI results in acute, sub-acute and chronic phases. It also allows identification of the longer term impact and how this may affect cognitive processes or potential engagement with therapy.
- Civilian studies have shown that within the chronic stage of TBI, fractional anisotropy (directional water diffusion in space) is increased, suggestive of axonal recovery processes (Jorge, Acion, White, Tordesillas-Gutierrez, Pierson, Crespo-Facorro & Magnotta, 2012).
- Studies have also shown differences in neurological outcomes for those sustaining a loss of consciousness (LOC) compared to alteration of consciousness (AOC) following the blast exposure.
- All of the studies included in this stage of review excluded those with reported substance or alcohol abuse within the past 30 days. This does not allow for a representative picture of veterans that sustained a mTBI, particularly those also experiencing posttraumatic stress symptoms who have known elevated rates of substance misuse.
- In summary, the articles initial searches in this ongoing review have revealed the heterogeneous methods used to capture neurological data for veterans who have sustained a mTBI.
- Despite this heterogeneity, all studies have revealed some degree of underlying neurological damage in at least some of the participants who sustained a mild TBI.
- Further work is desperately needed in this area to enable a clear and repeatable procedure for how those with mTBI, posttraumatic stress disorder and substance use should be defined and assessed for treatment indication is of great need.