McMaster University | HEALTH FORUM

Rapid Evidence Profile

Examining the association between the role of military breacher and sniper and the effects of mild traumatic brain injuries

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[MHF product code: REP 75]

Box 1: Evidence and other types of information

+ Global evidence drawn upon

Evidence syntheses selected based on relevance, quality, and recency of search

+ Forms of domestic evidence used (🍁 = Canadian)

Evaluation

Data analytics

*** Additional notable features**

Prepared in the equivalent of three-business days using an 'all hand- on deck' approach

Context

- Military Breachers and Range Staff (MBRS) experience repeated sub-concussive blasts, and some report symptoms consistent with mild traumatic brain injury (mTBI).(1)
- However, consequences of long-term exposure to low-level repetitive blasts, as well as injury thresholds, are still largely unknown.
- An overview of the evidence about the association between MBRS roles and mTBI can help better understand whether and to what extent these roles are more susceptible to mTBI, as well as approaches for prevention and monitoring and follow-up for MBRS.

Question

- What is the association between individuals who are occupationally exposed to repetitive low-level blasts and experiencing medium- to long-term effects (six months or more) of mild traumatic brain injury?

High-level summary of key findings

- Fourteen single studies were identified, of which six were assessed as high relevance.
- The current evidence on Military Breachers and Ranged Staff (MBRS) roles and mild traumatic brain injury (mTBI) is limited and methodologically diverse, making synthesis difficult.
- Some studies suggest MBRS experience more frequent and severe mTBI symptoms compared to staff in other roles, including post-concussive symptoms, cognitive and emotional disturbances, and other symptoms that can disrupt daily activities.
- However, studies consistently point out the difficulties of isolating the effects of repeated low-level blast exposures from other occupational hazards such as concussions and other exposures from deployments, making it difficult to attribute health outcomes directly to blast exposures.
- Findings from these studies suggest a potential need for updated safety protocols and better pre-exposure screening and continuous monitoring for MBRS.
- Future research should account for baseline differences and other exposures that MBRS experience to better understand the extent to which the relationship between repeated low-level blast exposure and mTBI symptomology and biomarkers can be attributed to the exposures.

Framework to organize what we looked for

- Type of breacher exposure
  - Type of blast
    - Primary (i.e., resulting from high pressure or overpressure created by explosions)
    - Secondary (i.e., resulting from strong winds following the blast wave that propel fragments and debris towards the body)
    - Tertiary (i.e., resulting from strong blast winds and pressure gradients that can accelerate and cause blunt force injury)
    - Quaternary (i.e., resulting from other explosive products and from exposure to toxic substances that can cause burns, blindness, and inhalation injuries)
    - Quinary (i.e., resulting from post-detonation environmental contaminants including chemical, biological, and radiological substances)
  - Type of non-blast exposure
  - Mixed exposure
  - Number of exposures
  - Intensity of exposures
  - Time between exposures
- Medium- to long-term sensory effects of mTBIs
  - Blurred vision
  - Sensitivity to light
  - Tinnitus
  - Changes in ability to taste or smell
- Medium- to long-term cognitive and mental health effects of mTBIs
  - Memory or concentration problems
  - Ongoing problems with speech
  - Dizziness or loss of balance
  - Mood changes
  - Depression
  - Anxiety
  - Difficulty sleeping
  - Fatigue
- Possible effect modifiers
  - Stage in a military career
    - Early

Box 2: Approach and supporting materials

At the beginning of each rapid evidence profile and throughout its development, we engage a subject matter expert who helps us to scope the question and ensure relevant context is taken into account in the summary of the evidence.

We identified evidence addressing the question by searching PubMed, CINAHL, and Web of Science. All searches were conducted on 7 June 2024. The search strategies used are included in Appendix 1. In contrast to synthesis methods that provide an in-depth understanding of the evidence, this profile focuses on providing an overview and key insights from relevant documents.

We searched for full evidence syntheses (or synthesis-derived products such as overviews of evidence syntheses) and protocols for evidence syntheses.

We appraised the methodological quality of evidence syntheses that were deemed to be highly relevant using the first version of the AMSTAR tool. AMSTAR rates overall quality on a scale of 0 to 11, where 11/11 represents a review of the highest quality, medium-quality evidence syntheses are those with scores between four and seven, and low-quality evidence syntheses are those with scores less than four. The AMSTAR tool was developed to assess reviews focused on clinical interventions, so not all criteria apply to evidence syntheses pertaining to delivery, financial, or governance arrangements within health systems or implementation strategies.

A separate appendix document includes:
1) methodological details (Appendix 1)
2) details about each identified synthesis (Appendix 2)
3) details about each included single study (Appendix 3)
4) documents that were excluded in the final stages of review (Appendix 4).

This rapid evidence profile was prepared in the equivalent of three days of a 'full court press' by all involved staff.

    - Mid
    - Late
  - Biological sex
    - Male
    - Female
  - Setting
    - Training
    - Deployed
  - Time to return to high-risk activities
  - Nature of protective equipment available (including the consistency with which it is worn and whether it fits correctly)
  - Mis- or delayed diagnosis
  - Co-morbid PTSD or mental health conditions
  - Other co-morbid chronic conditions

What we found

No evidence syntheses were identified for inclusion. Fourteen single studies were identified, of which six were assessed as high relevance.

Coverage by and gaps in existing evidence syntheses and domestic evidence

The available evidence provides some initial insights into the potential association between Military Breachers and Range Staff (MBRS) roles and mild traumatic brain injury (mTBI), but the paucity of available evidence and variations in methods used appear to have made synthesis of studies challenging. In particular, outcomes examined vary considerably, ranging from symptoms associated with mTBI such as headaches, changes in vision, balance, and cognitive and mental health outcomes, as well as some potentially relevant indicators or biomarkers of mTBI. Additionally, some evidence used cross-sectional designs that retrospectively examined histories of repeated blast exposures, making it challenging to separate these exposures from other types of exposures potentially relevant to mTBI.

Key findings from included evidence documents

Some evidence suggests that MBRS experience mTBI and symptoms associated with mTBI more frequently than colleagues in different roles. For example, two matched cohort studies found that a cohort of MBRS suffered greater post-concussive symptoms, reduced energy levels, impaired cognitive-motor integration, and poorer health.(1; 2) A cross-sectional study exploring self-reported histories of breachers' occupational exposure to repeated low-level blast and symptomology related to mTBI found that breachers reported more symptoms than non-breachers and rated these symptoms as more severe and significantly more disruptive to their daily activities.(3) Military breachers exposed to low-level blast events during training exercises in another study reported some poorer health outcomes, including higher scores on the cognitive and emotional symptoms as well as post-concussive symptoms such as sleep disturbance, despite finding no negative impact on neurocognitive performance immediately following blast exposure.(4)

However, some studies highlight the need to consider these impacts in relation to cumulative injuries and exposures from other sources such as concussions, deployments, and other occupational hazards. For example, a cross-sectional study highlighted that while MBRS exposed to low-level blasts demonstrated higher post-concussive symptoms compared to controls, recent blast exposure could potentially worsen post-concussive symptoms.(5) Similarly, a matched cross-sectional cohort study suggested that links between MBRS exposure to repeated low-level blasts and poor health outcomes should be considered in relation to the broader context of military members'

cumulative injuries and exposures from concussions, deployments, and other occupational hazards.(2) These studies highlight the methodological challenges of separating MBRS exposure to repeated low-level blasts from other occupational exposures, limiting the certainty that changes in outcomes are directly attributable to repeated low-level blast exposure. The effects of low-level blast exposures on MBRS may have differential impacts on individuals depending on their broader history of exposure and concussion history.

Additionally, some evidence assessed as medium relevance examined associations between exposure to repeated blasts and indicators/biomarkers that may be relevant for mTBI. This evidence varied greatly in its focus and presented mixed results. A prospective non-randomized cohort study of 11 breachers and four engineers exposed to repeated blast exposures during breaching training demonstrated no acute effects or longitudinal deteriorations in vestibular dysfunction after 17 months of follow-up, although one subject worsened with sequential recordings and important baseline differences were present, necessitating a larger study.(6) Similarly, in another study, no longitudinal effects were seen in biomarkers, behavioural characterization, and neuroimaging in military breaching early career soldiers with repeated low-level blast exposure.(7) Conversely, an observational study using blast sensors found that current training for military personnel involving overpressure and/or repeated low-level exposure can have negative impacts on the overall health of soldiers, suggesting that current safety distances exceeded 4 pounds per square inch (psi), the current safety threshold for blast exposure during training in the U.S.(8)

Next steps based on the identified evidence

Overall, studies highlight that additional or updated safety protocols and guidance for MBRS exposed to repeated low-level blast may be necessary. One study advocated for better pre-exposure screening and continuous monitoring to identify and manage brain abnormalities in MBRS exposed to repetitive blasts.(9) Findings from two other studies suggest that current blast exposure protocols and safety standards in the U.S. may not adequately protect against blast effects in urban environments, and the currently accepted safety distance thresholds of 4 psi may not be sufficient to avoid negative impacts of overpressure and repeated low-level exposure during training.(8; 10) Given the complex nature of mTBI and the potential role that repeated low-level blast exposure can play in initiating and/or worsening mTBI symptomology, future research should aim to better account for potential baseline differences among the study population, as well as other potentially relevant exposures faced by MBRS that may influence the presence of mTBI symptomology and biomarkers.

References

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