



Testimony

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# Repeated Exposure to Low- Level Military Occupational Blasts

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An Overview of the Research, Critical Gaps, and  
Recommendations

Addendum

CT-A3250-2

Document submitted May 1, 2024, as an addendum to testimony before the U.S. Senate Armed Services  
Committee, Military Personnel Subcommittee on February 28, 2024

For more information on this publication, visit [www.rand.org/t/CTA3250-2](http://www.rand.org/t/CTA3250-2).

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*Repeated Exposure to Low-Level Military Occupational Blasts: An Overview of the Research, Critical Gaps, and Recommendations*

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Addendum to testimony before the Committee on Armed Services  
Subcommittee on Military Personnel  
United States Senate

Submitted May 1, 2024

Following the hearing on February 28, 2024, the congressional committee sought additional information and requested answers to the questions in this document. The answers were submitted for the record.

## Questions from Senator Mazie K. Hirono

### Question 1

*Traumatic brain injuries can range from mild to severe, and studies have shown notable correlations between TBI and mental health conditions such as anxiety, PTSD, depression, and suicidality among current and former service members. Can you speak to this correlation and what steps are being taken to address treatment with this relationship in mind?*<sup>3</sup>

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<sup>3</sup> All questions are presented verbatim as they were submitted to RAND.

## Answer

My research has remained focused on traumatic brain injury (TBI) and subconcussive injuries, so, while I do know that there is a correlation between TBI and some mental health conditions, such as anxiety, posttraumatic stress disorder (PTSD), depression, and suicidality,<sup>4</sup> I do not feel qualified to speak to the correlation and any subsequent treatment efforts.

## Question 2

*If current medical approaches to treating TBI and related outcomes in American servicemembers are lacking or require additional resources, what alternative pathways are being explored to treating TBI from a holistic perspective?*

## Answer

Given my lack of clinical experience, particularly compared with others on the panel, I do not consider myself to be well positioned to answer this question. I will defer to my colleagues.

## Questions from Senator Elizabeth Warren

### Question 1

*What would be the benefits of establishing strategies specific to the Military Occupational Specialties (MOS) most at risk for blast overpressure?*

## Answer

Establishing strategies specific to the MOSs most at risk would allow for targeted prevention and mitigation efforts, which would offer several benefits. One is **improved occupational safety**. MOS-specific strategies would enhance the overall safety and well-being of the service members and reduce the likelihood of brain injury among personnel who are regularly exposed to blasts. Additionally, by safeguarding the health and well-being of service members in roles with known blast exposure risk, the military can maintain **higher levels of mission readiness and effectiveness**. Moreover, MOS-specific strategies would **better support post-service transition and veteran care** for veterans who may have been exposed to blast overpressure

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<sup>4</sup> Jennifer N. Belding, Claire A. Kolaja, Rudolph P. Rull, and Daniel W. Trone, "Single and Repeated High-Level Blast, Low-Level Blast, and New-Onset Self-Reported Health Conditions in the U.S. Millennium Cohort Study: An Exploratory Investigation," *Frontiers in Neurology*, Vol. 14, March 2023; Michelle R. Dickerson, Susan F. Murphy, Michael J. Urban, Zakar White, and Pamela J. VandeVord, "Chronic Anxiety- and Depression-Like Behaviors Are Associated with Glial-Driven Pathology Following Repeated Blast Induced Neurotrauma," *Frontiers in Behavioral Neuroscience*, Vol. 15, December 2021; Yueh-Chien Lu, Ming-Kung Wu, Li Zhang, Cong-Liang Zhang, Ying-Yi Lu, and Chieh-Hsin Wu, "Association Between Suicide Risk and Traumatic Brain Injury in Adults: A Population Based Cohort Study," *Postgraduate Medical Journal*, Vol. 96, No. 1142, December 2020; Trine Madsen, Annette Erlangsen, Sonja Orlovska, Ramy Mofaddy, Merete Nordentoft, and Michael E. Benros, "Association Between Traumatic Brain Injury and Risk of Suicide," *JAMA*, Vol. 320, No. 6, 2018; Sarah L. Martindale, Anna S. Ord, Lakeysha G. Rule, and Jared A. Rowland, "Effects of Blast Exposure on Psychiatric and Health Symptoms in Combat Veterans," *Journal of Psychiatric Research*, Vol. 143, November 2021.

during their military service. Lastly, establishing MOS-specific strategies would **allow for limited resources to be focused** where they are needed most.

### Question 2

*What are the benefits of establishing blast exposure and traumatic brain injury logs for service members?*

### Answer

These logs would allow the Department of Defense (DoD) to better track the frequency of low-level blast exposure, assess the occurrence among high-risk occupational specialties, determine the connection between exposure and health outcomes, and develop strategies to mitigate low-level blast exposure in training environments. Ultimately, in-depth exposure records could be used to develop an index score to gauge an individual's combat readiness and potential health risks.<sup>5</sup>

### Question 3

*Are you aware of cases where service members were retaliated against for coming forward about their injuries from blast overpressure and exposure?*

### Answer

I am not aware of any specific cases in which service members were retaliated against for coming forward about their injuries from blast overpressure and exposure. However, there is ample research on the underreporting of injuries among service members<sup>6</sup>—specifically, the underreporting of TBIs—and the reasons service members underreport, one of them frequently being concerns that reporting could have negative consequences. A 2020 study assessing unreported and untreated TBI among more than 5,000 soldiers concluded that, of those who reported a concussion, only 52 percent sought medical care. Of those who did not seek care, 18 percent were concerned that reporting might have negative repercussions on their careers. Additionally, 28 percent of soldiers who experienced a mild TBI (and 11 percent of soldiers who did not) reported that there is a stigma associated with mild TBI.<sup>7</sup> This stigma goes beyond TBI

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<sup>5</sup> Charles C. Engel, Emily Hoch, and Molly M. Simmons, *The Neurological Effects of Repeated Exposure to Military Occupational Blast: Implications for Prevention and Health: Proceedings, Findings, and Expert Recommendations from the Seventh Annual Department of Defense State-of-the-Science Meeting*, RAND Corporation, CF-380/1-A, 2019, [https://www.rand.org/pubs/conf\\_proceedings/CF380z1.html](https://www.rand.org/pubs/conf_proceedings/CF380z1.html); Lauren Fish and Paul Scharre, *Protecting Warfighters from Blast Injury*, Center for a New American Security, May 2018.

<sup>6</sup> Laurel Smith, Richard Westrick, Sarah Sauers, Adam Cooper, Dennis Scofield, Pedro Claro, and Bradley Warr, "Underreporting of Musculoskeletal Injuries in the US Army: Findings from an Infantry Brigade Combat Team Survey Study," *Sports Health*, Vol. 8, No. 6, November/December 2016.

<sup>7</sup> Sandra M. Escolás, Margie Luton, Hamid Ferdosi, Bianca D. Chavez, and Scot D. Engel, "Traumatic Brain Injuries: Unreported and Untreated in an Army Population," *Military Medicine*, Vol. 185, Supp. 1, January–February 2020.

and speaks to the culture across DoD—one in which there is stigma associated with seeking medical services and/or mental health treatment.<sup>8</sup>

#### Question 4

*What steps should DoD and the services take to encourage service members to seek treatment and help both during and after their career?*

#### Answer

Research shows that two common reasons service members do not seek treatment for TBIs relate to stigma and the belief that their injury did not require care,<sup>9</sup> the latter of which stems from a lack of education and awareness. Additional barriers to seeking treatment include logistical barriers and structural factors related to the military medical system (as detailed in Question 7).<sup>10</sup> Therefore, there are several options that DoD has to encourage service members to seek treatment. These include destigmatizing [mental] health care, enhancing the accessibility of services, implementing routine mental health screenings, training service members and leadership on the signs of [mental] health issues and potential brain injury, establishing clear, confidential channels for service members to provide feedback on care received and any barriers they encountered, and developing further peer support programs.<sup>11</sup>

#### Question 5

*What steps should DoD and the services take to encourage service members to follow safety measures to protect themselves from blast overpressure?*

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<sup>8</sup> Kyong Hyatt, Linda L. Davis, and Julie Barroso, “Chasing the Care: Soldiers Experience Following Combat-Related Mild Traumatic Brain Injury,” *Military Medicine*, Vol. 179, No. 8, August 2014.

<sup>9</sup> Joie D. Acosta, Wenjing Huang, Maria Orlando Edelen, Jennifer L. Cerully, Sarah Soliman, and Anita Chandra, *Measuring Barriers to Mental Health Care in the Military: The RAND Barriers and Facilitators to Care Item Banks*, RAND Corporation, RR-1762-OSD, 2018, [https://www.rand.org/pubs/research\\_reports/RR1762.html](https://www.rand.org/pubs/research_reports/RR1762.html); Escolas et al., 2020; Hyatt, Davis, and Barroso, 2014; Marie-Louise Sharp, Nicola T. Fear, Roberto J. Rona, Simon Wessely, Neil Greenberg, Norman Jones, and Laura Goodwin, “Stigma as a Barrier to Seeking Health Care Among Military Personnel with Mental Health Problems,” *Epidemiologic Reviews*, Vol. 37, January 2015; Terri Tanielian, Mahlet Woldetsadik, Lisa Jaycox, Caroline Batka, Shaela Moen, Carrie Farmer, and Charles C. Engel, “Barriers to Engaging Service Members in Mental Health Care Within the U.S. Military Health System,” *Psychiatric Services*, Vol. 67, No. 7, July 2016.

<sup>10</sup> Acosta et al., 2018; Tanielian et al., 2016.

<sup>11</sup> Donald Berwick, Katherine Bowman, and Chanel Matney, eds., “Traumatic Brain Injury Prevention and Awareness,” in *Traumatic Brain Injury: A Roadmap for Accelerating Progress*, The National Academies Press, 2022; Kathryn E. Bouskill, Carrie M. Farmer, Irineo Cabrerros, Jonathan H. Cantor, Natalie C. Ernecoff, Lynn Hu, Shira H. Fischer, Aaron Kofner, Lisa S. Meredith, Matthew L. Mizel, Aneesha Motala, Tepring Piquado, Zachary Predmore, and Rajeev Ramchand, *Improving Care for Veterans with Traumatic Brain Injury Across the Lifespan*, RAND Corporation, RR-A1205-1, 2022, [https://www.rand.org/pubs/research\\_reports/RRA1205-1.html](https://www.rand.org/pubs/research_reports/RRA1205-1.html); Escolas et al., 2020; Michael S. Jaffee, “Traumatic Brain Injury and the Military Health System,” in David Butler, Jessica Buono, Frederick Erdtmann, and Proctor Reid, eds., *Systems Engineering to Improve Traumatic Brain Injury Care in the Military Health System: Workshop Summary*, The National Academies Press, 2009; School of Education and Human Development, Texas A&M University, “Support for Family Caregivers After Military Traumatic Brain Injuries,” November 27, 2018.

## Answer

Perhaps the most effective way to encourage service members to follow safety measures is through education and awareness. Service members and leadership need authoritative information about the dangers of blast overpressure, including its sources and the potential short- and long-term health consequences. Regular training and awareness campaigns can help personnel understand why protective measures are necessary and how they can effectively mitigate risks.<sup>12</sup> Additionally, the dissemination of safety equipment that is both validated and functional will encourage safety members to protect themselves from blast overpressure.

## Question 6

*What are the biggest gaps in information getting to service members and their families about blast overpressure risks and symptoms, as well as options for treatment?*

## Answer

My research has not focused on this, so I will defer to my colleagues to answer this question.

## Question 7

*What are the biggest barriers to service members seeking and obtaining treatment for blast overpressure and exposure?*

## Answer

While there is little to no research on the barriers that prevent service members from seeking and/or obtaining treatment specifically for blast overpressure and exposure, there is some research on barriers that prevent service members from seeking treatment for TBI and further research on barriers related to the treatment of mental health and other health issues. Barriers include those that are purely logistical (e.g., difficulty scheduling an appointment<sup>13</sup>); structural factors associated with the military medical system (e.g., limited capacity of the system, limited number of providers available to address needs);<sup>14</sup> a lack of knowledge of the risks of exposure to lower-level blasts;<sup>15</sup> and institutional attitudes and cultural issues, also known as *public stigma*<sup>16</sup> (e.g., perceived attitudes held by leadership,<sup>17</sup> concerns that seeking care could have negative career repercussions<sup>18</sup>).

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<sup>12</sup> Berwick, Bowman, and Matney, 2022.

<sup>13</sup> Acosta et al., 2018.

<sup>14</sup> Tanielian et al., 2016.

<sup>15</sup> Escolas et al., 2020.

<sup>16</sup> Tanielian et al., 2016.

<sup>17</sup> Acosta et al., 2018; Sharp et al., 2015; Tanielian et al., 2016.

<sup>18</sup> Escolas et al., 2020; Hyatt, Davis, and Barroso, 2014; Tanielian et al., 2016.