SYSTEMATIC REVIEW

Forensic neuropsychopathological analysis on altered brain structures in combat veterans: A systematic review [version 1; peer review: awaiting peer review]

Monique M. Chouraeshkenazi

Humanities, Arts, & Education, American Public University System, American Military University, American Military University, Charles Town, West Virginia, 25414, USA

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Abstract

American combat veterans who served in OIF and OEF were diagnosed with severe neuropsychopathologies due to combat exposure and trauma. Studies on how combat exposure and trauma alter brain cortical structures were explored. The objective was to examine if combat veterans can remain on active duty or if they are predisposed to commit violent crimes was considered. However, limited data raised concerns about criminal responsibility for violent crimes. As evident, combat veterans with severe neuropsychopathologies do not meet personnel readiness standards, impacting military service obligations and national security operations.

A systematic literature review included combat exposure effects and trauma on the brain. Data analysis processes were utilized using the PRISMA model to review pre-existing studies. Results revealed PTSD, mTBI, and depression comorbidities were leading neuropsychopathologies among combat veterans. Findings uncovered altered frontal lobes and anterior prefrontal cortex regions. Also, evidence showed combat veterans diagnosed with PTSD and depression were more likely to commit violent crimes. However, preliminary research could not determine if combat veterans are criminally liable, although they met the criteria for the insanity defense. Forensic neuropsychopathology identified the relationship between these conditions and the military legal system. Further research is recommended to examine severe neuropsychopathologies and affected brain regions through neuroimaging and advanced neuropsychological initiatives to improve mental healthcare practices within DoD.

Keywords

combat exposure, combat veterans, crime, forensic neuropsychopathology, military law, trauma, violent crime

Open Peer Review

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Any reports and responses or comments on the article can be found at the end of the article.

Corresponding author: Monique M. Chouraeshkenazi (mchouraeshkenazi@gmail.com)

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Introduction

U.S. service members diagnosed with comorbid neuropsychopathologies were predisposed to committing violent crimes after serving in Operation Iraqi Freedom (OIF) and Operation Enduring Freedom (OEF) campaigns. Furthermore, white male service members diagnosed with PTSD, mTBI, and depressive comorbidities had the highest rate of violent crimes among active service members of the U.S. Armed Forces following OIF and OEF deployments (Krancevich, 2020; MacQuarrie *et al.*, 2020; Giardino, 2019; Sreenivasan *et al.*, 2013). Following the September 11th attacks and subsequent deployments, the increase in mental health conditions significantly impacted military force structure and mission readiness operations (Acosta *et al.*, 2014).

The radical shift from combatting the Global War on Terrorism (GWOT) to fighting the war on mental health is a new threat. Since the establishment of the U.S. Armed Forces structure, it has been mandated that service members are mentally and physically fit (identified as personnel readiness obligations) to remain on active duty (Deployment Health Clinical Center [DHCC], 2017). Personnel readiness is the "ability of the military forces to fight and meet the demands of assigned missions. Readiness standards include individual and unit training, physical preparedness, personnel and equipment availability, and capability" (Dempsey, 2017, p. 1). Severe neuropsychopathologies and violent crimes reduce the effectiveness of personnel readiness obligations, which affects the U.S. Department of Defense's force structure and mission readiness requirements (DHCC, 2017). If the Department of Defense (DoD) does not have a mentally and physically fit force, it can threaten its national security efforts.

The OIF and OEF campaigns covered 13 years and impacted over 2 million service members who aided in combat and support operations (Brown University, 2021; National Academies Press, 2010). Over half of the 2.8 million who served in Iraq and Afghanistan deployed multiple times (Brown University, 2021). Additionally, an estimated 50% were diagnosed with severe psychopathologies following the campaigns, restricting their personnel readiness obligations (Armed Forces Health Surveillance Branch [AFHSB], 2017). As a result, the surge in mental health cases considerably burdened the military healthcare system (Cohen *et al.*, 2015). Furthermore, severe neuropsychopathologies have been associated with violent crimes committed by military service members (Cesur *et al.*, 2020; Krancevich, 2020; MacQuarrie *et al.*, 2020; Giardino, 2019; MacManus *et al.*, 2015; Rosellini *et al.*, 2015; Stone, 2015).

Understanding that the DoD faces new challenges for readiness operations, it is essential to examine the efficacy of neuropsychopathological services for active service members (Hepner *et al.*, 2014). Moreover, reviewing such initiatives is essential, as there are insufficient neuropsychopathological studies to examine how to combat exposure, severe mental illnesses, brain injuries, and related psychopathologies that alter brain functioning (Clausen *et al.*, 2019; Averill *et al.*, 2017; National Institutes of Health, 2007). Therefore, a systematic literature review was used to deduce data from studies that address the impact of combat exposure and trauma on different brain cortical structures in military service members.

Simultaneously, a secondary analysis review was conducted to examine the connection between increased rates of violent crimes committed by service members diagnosed with severe neuropsychopathologies and significant changes in different cortical structures of the brain. Examining neuropsychology and psychopathology (i.e., neuropsychopathology) was vital in answering research questions regarding combat exposure, trauma, and the brain. Also, forensic neuropsychopathology was essential to establish advanced research of abnormal brain conditions linked to mental illness comorbidities and how it impacts the legal justice system. Studying the cortical brain structures of service members exposed to combat and trauma was vital in understanding the association between severe neuropsychopathologies and violent crimes, influencing personnel readiness obligations and national security efforts. Understanding these dynamics provided essential recommendations for further research to suggest improvements in healthcare services for military personnel.

Background of the problem

Little is known about how severe neuropsychopathologies are correlated to violent crimes committed by service members. Increased severe neuropsychopathological cases increased the number of violent crimes committed by service members and indubitably affected personnel readiness obligations that threaten force structure and mission readiness requirements (Umbrasas, 2020; Acosta *et al.*, 2014). Hence, this study examined the impact of combat exposure and trauma on different cortical brain structures in U.S. military service members. Additionally, literature in the field of forensic neuropsychopathology was explored. Studying the brain alterations in service members was essential in understanding the impact of combat exposure and trauma and its contribution to violent crimes.

While the DoD has improved mental health initiatives for the active component of the military, there is a need for neuropsychopathological services to understand the complexities of how severe mental illnesses impact different cortical structures and brain structures. Also, there should be advanced forensic neuropsychopathological studies to determine

how abnormal brain conditions and mental health comorbidities affect service members who commit violent crimes. Since 2016, nearly 1 million service members have been diagnosed with a mental health condition responsible for at least 16%, or approximately 1.8 million medical appointments (AFHSB, 2017). As a result, mental illness has been the leading service discharge for men and women, as the second-leading discharge type (Kudler, 2018). Also, severe neuropsychopathologies have bolstered violent crimes like domestic violence, mass shootings, murder, and robbery (Franke, 2014; Weeks *et al.*, 2017; Rusu *et al.*, 2016; Goodwin *et al.*, 2015; McGuire *et al.*, 2015). Such crimes have led to dishonorable discharges from military service and have increased court-martial proceedings (Victim and Witness Assistance Council, n.d.). Research has also revealed that severe neuropsychopathologies have been perilous in criminal responsibility for service members to stand trial (Umbrasas, 2020).

Increases in severe neuropsychopathologies and violent crimes restrict military service members' personnel readiness obligations (Ulrich *et al.*, 2019; Brooker *et al.*, 2014). In addition, combat-related illnesses are expected to increase by over 50% within the next 20 years due to GWOT (Acosta *et al.*, 2014). Thus, studying the impact of combat exposure and trauma on different cortical brain structures provided a breakthrough delineated in implications for professional practice and recommendations for future research to examine service members' ability to remain on active duty.

Statement of the problem

Military service members exposed to combat and traumatic events are at higher risk for severe neuropsychopathological diagnosis, potentially having long-term effects on the brain. Such conditions pose a significant challenge for the DoD, as evidence purported that at least 50% of service members who returned from OIF and OEF campaigns were diagnosed with one or more mental health conditions (U.S. Department of Veterans Affairs, n.d., para. 1). Notably, male service members diagnosed with severe neuropsychopathologies and comorbid conditions had the highest rate of violent crimes among active service members following OIF and OEF (Krancevich, 2020; MacQuarrie *et al.*, 2020; Giardino, 2019; Sreenivasan *et al.*, 2013). In addition, severe neuropsychopathologies have been associated with violent crimes committed by military service members (Cesur *et al.*, 2020; Krancevich, 2020; MacQuarrie *et al.*, 2020; Giardino, 2019; MacManus *et al.*, 2015; Rosellini *et al.*, 2015; Stone, 2015).

Though the DoD has improved mental health initiatives to provide neuropsychological services, there are limited *forensic neuropsychopathological* initiatives to examine how such mental health conditions impact different cortical brain structures and the predisposition of service members to commit violent crimes (Clausen *et al.*, 2019; Averill *et al.*, 2017). Exploring this phenomenon was vital, as increased violent crimes and associated military discharges by active service members negatively impact national security initiatives (Cesur *et al.*, 2020; Krancevich, 2020; MacQuarrie *et al.*, 2020; Giardino, 2019; Acosta *et al.*, 2014; Elbogen *et al.*, 2014). Such challenges affect the mental and physical fitness standards for the active duty component of the Armed Forces, reducing their readiness capabilities to remain on active duty (Brignone *et al.*, 2017; DHCC, 2017). These challenges are a vital threat to national security initiatives because DoD mandates a mentally and physically fit force to complete the missions of the U.S. Armed Forces (DHCC, 2017).

Purpose of the study

This systematic literature review explored the impact of combat exposure and trauma on different cortical brain structures due to severe neuropsychopathologies experienced by service members. The research focused on U.S. Army service members, the largest population to serve in combat deployments (U.S. Department of Defense, n.d.). Additionally, this study will examine how these conditions predispose service members to commit violent crimes. Exploring the association between the brain and neuropsychopathologies was essential due to increased mental health diagnoses and discharges from active service following deployment campaigns (U.S. Department of Veterans Affairs, n.d., para. 1). Additionally, the aftermath of deployments and mental diagnoses have been responsible for the proliferation of violent crimes committed by service members (Krancevich, 2020; MacQuarrie *et al.*, 2020; Giardino, 2019; Sreenivasan *et al.*, 2013).

Research questions

RQ1. How do combat exposure and trauma change different cortical structures and brain performance?

RQ2. How can service members with severe neuropsychopathologies remain on active duty?

RQ3. What are the connections between severe neuropsychopathologies and committing violent crimes?

> ***SQ1.*** How can service members with severe neuropsychopathologies return to active duty if they are found not criminally responsible for violent crimes committed?

RQ4. How can policymakers, defense leadership, and military legal professionals work with mental health experts to develop neuropsychopathological initiatives?

Methods

A systematic literature review was best suited for this study. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) model was the chosen data collection instrument to review many existing studies. Relevant articles were reviewed using tables containing service members' characteristics that met selected criteria to maintain quality assessments and reduce potential bias. This study was predicated on a complex theme that introduced a conceptual framework and required numerous existing studies to support it. Therefore, reviewing existing studies was vital for gathering evidence to answer the research questions for this project.

Pertinent articles were examined using a diagram containing service members' characteristics that meet selected criteria to maintain quality assessments and reduce potential bias. This study is predicated on a complex theme that introduces a conceptual framework and requires many existing studies to support it. Therefore, reviewing existing studies was vital for gathering evidence to answer the research questions for this project.

Also, the systematic literature review approach and PRISMA model were most befitting for a complex theme that introduces a conceptual framework (i.e., forensic neuropsychopathology). The review of current studies was essential for gathering evidence to answer the research questions for this project. Emerging the ideal of forensic neuropsychopathology requires a significant amount of qualitative data, particularly from neuropsychopathology, psychopathology, and forensic psychology studies, to identify distinctive themes and patterns to support this research. In past studies, amalgamating a systematic review approach and a conceptual framework has effectively reduced limiting factors between research and practice in fields (Peterson *et al.,* 2019; Saunders *et al*., 2019; Kranz & Mueller-Block, 2015; Hallinger, 2013).

The methodology approach was used to extrapolate data from similar studies that address the impact of combat exposure and trauma on different brain structures of service members. This method was integral in conducting secondary analyses on an abundance of neuroscientific studies to examine how these psychopathologies affect the structure and performance of the brain. Systematic analysis practices were conducted to examine the connection between increased rates of violent crimes committed by service members diagnosed with severe neuropsychopathologies and changes in brain structures.

Examining neuropsychology and psychopathology (i.e., neuropsychopathology) was vital in answering specific research questions regarding combat exposure, trauma, and the brain. Studying the different cortical brain structures of combat service members' brains is critical to understanding the association between severe neuropsychopathologies and violent crimes, influencing personnel readiness obligations to remain on active duty. An understanding of these dynamics could lead to enhancing mental health services for military personnel.

The approach establishes criteria to determine which data will be included or excluded before creating the literature review (Charrois, 2015). This research design mitigates the risk of bias, increasing the reliability of the findings from established studies (Peterson *et al.,* 2019). Also, the systematic review approach was appropriate because the research objective of the study produced distinctive methodologies while ensuring that the selected studies met the established criteria through a comprehensive search strategy (Charrois, 2015). Furthermore, the approach can assess the validity of the findings outlined in the included studies and systematically synthesize the data (Gopalakrishnan & Ganeshkumar, 2013).

The forensic neuropsychopathology conceptual model required significant qualitative data, particularly in neuropsychology and psychopathology (i.e., neuropsychopathology), to identify distinctive themes and patterns, examine data, and answer the research questions. Neuropsychopathology is the scientific study of how mental health diseases affect the brain and the nervous system. In past studies, amalgamating a systematic review approach and a conceptual framework has effectively reduced the informational gap between research and practice (Peterson *et al.*, 2019; Saunders *et al.*, 2019; Kranz & Mueller-Bloch, 2015; Hallinger, 2013).

Incorporating this research design and conceptual framework provided clear-cut language scholars can use to conduct and evaluate future research in neuropsychopathology. This research study collected data from various academic, government, and medical databases. Such databases collect scholarly journals for research studies and projects for subject-specific publishing (University of Massachusetts, 2023).

Limitations and delimitations of the study

The limitations of this study were based on specific factors, such as complex issues in neuropsychology and the concept of forensic neuropsychopathology, that impacted the interpretation of the findings. Certain restrictions impacted this research using the systematic review and PRISMA model approaches. However, there were a plethora of studies that

examined neuropsychology and psychopathology independently. Using the systematic approach provided sufficient data to establish critical themes vital to results and findings. Dehabreh *et al.* (2012) asserted that some research topics do not produce valuable summaries based on previous studies to establish themes and patterns during the review process. Additionally, biopsychosocial information and medical knowledge may be difficult to obtain unless service members actively participate in research studies or release applicable information. Without biopsychosocial data, a significant research study population is limited (Bolton & Gillet, 2019; Benning, 2015).

Another potential challenge was having adequate population and demographic data focusing on service members who remain on active duty with a severe psychopathological diagnosis. Banerjee and Argaez (2017) and Dehabreh *et al.* (2012) reported that systematic reviews might not provide sufficient participant and demographic information to analyze commonalities among specific datasets. This issue is vital when focusing on a particular population, such as combat and trauma-exposed service members; this population can provide substantial evidence supporting the need for forensic neuropsychopathological initiatives within DoD. Therefore, such limitations can produce unclear data due to insufficient population and demographic information, duplicate information, excluding studies, and ambiguous bias (Banerjee & Argaez, 2017).

Additionally, researcher bias could have been a potential limitation because of the professional connection to the military and the passion for neuropsychopathology, which can cause invalid results and inaccurate conclusions. It was vital to address researcher bias because it allows reviewers to independently review the literature and avoid certain events potentially harmful to the study (Pannucci & Wilkins, 2010). Also, there is a systematic bias in an" all voluntary force" where recruitment may not provide sufficient screening processes, reducing the appropriate manpower for the U.S. Armed Forces (Asoni *et al.,* 2020).

Some delimitations are examining and reporting forensic neuropsychopathological issues that can lead to discharges and violent crimes. For this study, service members who suffer from combat exposure and trauma and are diagnosed with severe neuropsychopathologies were the basis of this research project. Understanding the limitations and delimitations of this study was vital to the outcome of the findings in potentially providing a breakthrough in neuropsychopathology to improve mental health initiatives within the DoD.

Participants

This systematic literature review study introduced a conceptual framework (i.e., forensic neuropsychopathology); therefore, it was not warranted to research human subjects. Instead, participants were drawn from selected evidence-based studies. U.S. service members (i.e., active duty and recently discharged veterans) are the sampling population. The populace was based on the number of participants in the selected, evaluated studies. The size depended upon the amalgamation of the number of OIF and OEF veterans of a specific period (i.e., 2006-2015) that participated in studies involving severe neuropsychopathologies, trauma, combat exposure, military discharges, and violent crimes from the selected studies. Table 1 denotes the veteran population.

Table 1. Demographics and military characteristics of Active Duty Veterans of Post-9/11 Conflicts in Iraq (OIF) and Afghanistan (OEF).

Characteristics	Women		Men	
	Routine	Misconduct	Routine	Misconduct
Mean age at first encounter	31.5	26.7	31.6	26.7
Race/Ethnicity				
White	9,804	569	112,875	8,431
Black	5,938	488	26,287	3,463
Hispanic	2,431	118	20,498	1,490
Other/Unknown	2,662	88	22,680	786
Education level				
High School/Equivalent	15,912	1,127	151,753	13,077
Beyond High School	4,577	116	27,652	846

Table 1. *Continued*

Characteristics	Women		Men	
	Routine	Misconduct	Routine	Misconduct
Marital status				
Never Married	11,709	856	100,536	9,685
Married	7,631	356	77,184	4,292
Divorced/Other	1,430	46	4,402	177
Branch of service				
Army	8,041	720	74,437	8,674
Marines	1,832	44	45,560	1,375
Air Force	5,380	234	26,384	1,345
Navy/Coast Guard	5,573	265	34,956	2,776
Rank				
Enlisted	18,994	1,212	169,982	13,874
Officer	1,841	51	12,357	296

Note. Department of Veterans Health Administration, 2006-2015.

Participants were selected based on stratified random sampling within the experimental studies assessed. Stratified sampling divides populations into standardized subpopulations called strata and is predicated on distinctive characteristics. According to Howell *et al.* (2020), stratified random sampling increases sample representativeness by dividing such groups that the researcher finds significant. In this process, the participants were partitioned into subpopulations based on the following characteristics: *age, criminal history, deployment record, discharge information, mental health history, neurological history, type and stage of mental health illness, service branch, socioeconomic status, traumatic experiences, treatment history,* and *years of service.* Table 2 below denotes such characteristics.

Instrumentation

This research study used various academic, government, and medical databases as data collection instruments. Such databases collect scholarly journals for research studies and projects for subject-specific publishing (University of Massachusetts, 2023). Scholarly journals are peer-reviewed articles based on original research and experimentations in a particular discipline and are usually published by universities and professional societies (Cornell University, 2023). This data collection technique provided historical and current information to establish a new concept and answer the research questions.

The following databases were used: *Academic Press, Academic Search, Air Force Research Laboratory, Air War College, APA PsycNet, American Medical Association Journals, BioMed Central Journal Publications, Brain Health Education & Research, British Journals of Medicine, BMC Psychiatry, Catalog of U.S. Government Publications, Congressional Research Service, CQ Researcher, Current Psychology Letters: Behavior, Brain, & Cognition, Directory of Open Access Journals, EBSCO Information Services, eNeuro, FreeMedicalJournals, Frontiers in Psychology, Genomics JournalSeek, Google Scholar, Government Research Centers Directory, History of Neuroscience, Janus*

Table 2. Frequencies and descriptions for subcategories selected categories of comorbidity over 5 years of VHA follow-up among Active Duty Veterans of Post-9/11 Conflicts in Iraq (OIF) and Afghanistan (OEF).

Psychiatric Disorders	Women (Percentage)		Men (Percentage)	
	Routine	Misconduct	Routine	Misconduct
Post-Traumatic Stress Disorder	52.1	63.7	73.3	76.0
Depressive Disorders (without psychotic features)	69.4	72.0	45.6	55.6
Adjustment Disorder	30.1	31.2	29.3	29.3
Schizophrenia and other psychotic disorders	48.4	66.7	58.0	74.6
Depressive Disorders (with psychotic features)	47.7	28.6	36.6	21.6

Note. Department of Veterans Health Administration, 2006-2015.

Head, Journal of Neuroscience, JSTOR, Library of Congress, Medical Surveillance Monthly Report, Medline, Military Government Collection, Microsoft Academic Search, Military Psychology, National Academy Press, National Defense Research Institute, National Institutes of Health, National Institute of Mental Health, National Academy Science, Neuroanatomical, Neurophysiology, & Neuropsychological Terminology, Neuroscience Information Network, Neuroscience of Intelligence, Open Science Directory, Oxford Journals, Person-Centered Journal, ProQuest Research Library, PLOS Medicine, PsycCentral, PsycInfo, PsychiatryOnline, PTSD Research Quarterly, Public Library of Science, PubMed Central, Rand Corporation, ResearchGate, SAGE Journals, ScienceDirect, Semantic Scholar, Small Wars Journal, Taylor & Francis, U.S. National Library of Medicine National Institutes of Health, and Web of Science.

Interviews and surveys that require the participation of human subjects were not used to obtain the original information. Also, experiments were not used to prove any hypotheses or obtain statistical information. Therefore, these data collection instruments were expanded to classify and describe critical characteristics in the literature review to answer the research questions. This is important because a comprehensive review of qualitative data is needed for the complexity of this research topic.

Data collection

The steps for selecting scholarly articles for this research were similar for most databases; however, there were differences based on the type of archives (i.e., *Google Scholar* web search engine or university publications). Therefore, the following steps will be used for academic databases:

1. Go to Google and enter the database URL in the search engine (*Medline – National Library of Medicine*).

2. Then, go to the database's search engine and type keywords such as *"clinical psychology," "force structure," "forensic psychology," "military discharge," "military law," "military service members," "mission readiness," "neuroplasticity," "neuropsychology," "neuropsychopathology or neuropsychopathologies," "neuroscience," "Operation Enduring Freedom," "Operation Iraqi Freedom," "personnel readiness," "psychopathology or psychopathologies," "PTSD," "severe mental illnesses," "violent crimes."*

3. The title of each article topic was reviewed to determine if it was relevant to the research topic, and then the information was entered into Microsoft spread for further review. The tab was titled "Data Collection – Spreadsheet Review (Preliminary)" (Appendix B). NOTE: The first three steps were completed for each government, professional, and university database until approximately 150-200 research articles were chosen for review).

4. After the databases and the spreadsheet were completed, the articles were grouped by topic (i.e., clinical neuropsychopathology, neuropsychopathology, psychopathology, military psychology, etc.). Finally, each article's abstract was reviewed to determine if the topic, processes, findings, and results were relevant to this study's literature review.

5. Research articles were separated into different tabs on the Microsoft spreadsheet. Additionally, relevant research articles were copied and pasted on the new tab. The tab was titled "Data Collection – Spreadsheet Review (Provisional)" (Appendix C).

6. Relevant research articles were reviewed in their entirety to gather critical information (i.e., current findings) needed to support the literature review.

7. Current findings necessary for the literature review were copied and pasted to a new tab. The tab was titled "Data Collection – Spreadsheet Review (Selected Literary Findings)" (Appendix D). NOTE: Articles selected for the literature review were categorized by field (i.e., forensic psychology, military law, neuroscience, neuropsychopathology, etc.). The fields are denoted by color and are reflected in the mapping process.

    a. Neuroscience = green

    b. Neuropsychology = red

    c. Psychopathology = blue

d. Neuropsychopathology = yellow

e. Neuroplasticity = orange

f. Forensic Psychology = purple

g. Military Service Obligations & Law = grey

h. Violent crimes and military service members = black

Classifying each category by color is another strategy to identify themes and patterns when analyzing data to answer the research questions in this study.

8. The research articles tabbed under "Literature Review" were entered into the NVivo. NVivo is a qualitative data analysis software system that assists researchers in organizing and analyzing unstructured data (Lumivero, 2023).

9. The research articles' information was uploaded in the NVivo software to organize the data and provide structure to review critical information quickly.

10. Once the information was organized, patterns and themes were reviewed to identify commonalities vital for the literature review.

11. Next, qualitative themes (Appendix E) were identified to address topics vital to answering the research questions. Then, the schemes were divided into datasets to ascertain data that may have been hidden within the literature. Identifying themes is essential because it assists in producing an account of the data better to understand it (Nowell *et al.*, 2017). Finally, themes were uncovered in the mapping data process, inter-connecting information based on the literature and producing datasets.

12. After identifying patterns and themes, a mapping process (Appendix F) correlated coding categories, patterns, and themes to the research questions. Mapping is a method used to illustrate how concepts are related (Perryman, 2016). This is essential because military codes identified in other categories are crucial to establishing strong support for incorporating such data in an emerging study (Maldonado, 2015).

13. Once the mapping process was completed, an initial coding model (Appendix G) was developed to identify the primary code patterns derived from the research studies included in the NVivo software program. The coding model process defines the data that the research analyzes (Allen, 2017).

14. After the model was completed, the data was used for analyzing and identifying results in Chapter Four.

Inclusion and exclusion criteria

Inclusion criteria are distinctive features for a target population chosen for investigators to answer research questions (Patino & Ferreira, 2018, para. 2). This is an essential strategy when researchers design high-quality study protocols. Generally, inclusion criteria consist of clinical, demographic, and geographic descriptions (Patino & Ferreira, 2018). This study's criteria will be predicated on clinical and demographic data. They are the basis for analyzing data to generate patterns and themes to answer the research questions. Each scholarly and peer-reviewed article should have clinical data predicated on severe psychopathologies, neuropsychology, and forensic psychology, about active service members in the U.S. Armed Forces. Additionally, the clinical data should involve military service members who served who were exposed to combat or experienced trauma, particularly following the OIF and OEF campaigns.

The selected articles must have included data concerning military discharges due to severe psychopathologies and violent crimes. Also, scholarly publications included findings and results that incorporate forensic psychology and the military justice system. Access to military databases was beneficial in gaining data that provides the demographics of active service members. The demographics will focus on *age, criminal history, deployment record, discharge information, mental health history, type and stage of mental health illness, neurological history, service branch, socioeconomic status, traumatic experiences, treatment history,* and *years of service* of male military service members.

External criteria are characteristics that meet inclusion criteria but have additional characteristics that could inhibit the study's success or lead to potentially adverse outcomes (Patino & Ferreira, 2018, para. 2). This study cannot include specific characteristics because they do not meet standards that align with all inclusion criteria standards. Additionally, some characteristics will not be included because they are ineligible for the study. During the review process, articles that will not be included in this study are the following:

- Have not served in combat deployments.
- Have not experienced a traumatic event(s).
- Serve in support roles (i.e., non-dangerous military positions).
- Currently imprisoned.
- Served in combat roles but was not diagnosed with a severe mental health condition.
- Diagnosed with a traumatic brain injury.
- Military discharge not coded for a medical condition or for committing illegal acts (particularly violent crimes) violates the Uniformed Code of Military Justice (UCMJ).

The purpose of establishing inclusion and exclusion criteria is to regulate extraneous variables and ensure representative samples are carefully created within a study. The impact of inclusion and exclusion criteria to determine the study's validity requires in-depth knowledge of the area of research and an explicit understanding of how specific criteria impact the external validity (Patino & Ferreira, 2018; Garg, 2016). In addition, identifying inclusion and exclusion criteria increases the chances of developing reliable and reproducible results, which can mitigate the probability of harm to the study (Yale University, 2023).

Benefits of data

Data collection is a process that gives researchers the autonomy to customize their research objectives to specific purposes (Billups, 2020). Researchers control and standardize research processes to increase reliability and validity (Billups, 2020). Data collection is crucial as it provides much information that experts can use to make informed decisions. It allows researchers to have the most up-to-date trends to solve problems and offer new insights into respected fields of study. The benefits of data are that this study is focused on providing data for congressional leaders, policymakers, and military leadership to improve mental health initiatives within the U.S. Armed Forces' active service components to understand better how military service responsibilities impact the brain. Additionally, introducing a new concept, neuropsychopathology, as the foundational basis of advanced research in clinical psychology and neuropsychology is pivotal in examining how to combat exposure and trauma increases the probability of severe mental illness diagnoses of active service members.

Data analysis

Data analysis is a procedure utilized to inspect, model, or transform information to determine helpful information to provide resolutions and make informed decisions (Billups, 2020). The analysis process can apply statistical data with analytical techniques to "describe, illustrate, condense, recap, and evaluate data" (The Office of Research and Integrity, n.d., para. 1). In addition, utilizing data analysis provides analytical procedures to offer additional insight of eliciting inductive inferences from data and distinguishing the indicator (the phenomenon of interest) from distractions (statistical variability) that are present within the data (The Office of Research and Integrity, n.d., para. 1).

Specific data analysis processes were used, and research factors were considered.

Research bias can pose a weakness study, as the researcher is a U.S. Air Force veteran. Furthermore, personal and professional relationships in the military can influence the data derived from this study. Additionally, familiarity with the mental healthcare process within the U.S. Armed Forces can provide bias and skew information based on its progression. According to Pannucci and Wilkins (2010), researcher bias can occur at any study phase. Therefore, establishing an effective process to mitigate bias is imperative in research.

Validity is vital in ensuring the legitimacy of a complex research project involving multiple components that influence various aspects of the U.S. Armed Forces. The authenticity of a research study establishes significance when new data

analysis tools are introduced by using a credible process (i.e., a rubric for analyzing the validity of a process). In addition, using a legitimate model can significantly mitigate verification and validity issues in research (Carter *et al.*, 2014).

For this study, data triangulation was used to increase the validity of the data analysis process. Data triangulation uses multiple methods to collect data (Carter *et al.*, 2014). Triangulation is one of the various forms to ensure the validity of the research. The basis for the data analysis process will be academic, government, and professional databases to obtain scholarly and peer-reviewed articles to analyze for the literature review. Utilizing the data triangulation process through databases, an aggregate data tool and archival records can increase the validity of this study.

Research reliability is the extent to which research methods produce stable and consistent results. Measures within research results are considered reliable if the same object of measurement is used several times and produces the same result (Heale & Twycross, 2015). Reliability is a necessary process that improves the credibility of a study. Like validity, the data triangulation method will be used to ensure the reliability of this research project.

Theoretical framework

Resilience theory is a theoretical model that examines how individuals recover from adverse situations (Zimmerman, 2013). The concept of resilience is to understand how people deal in the aftermath of an event rather than the nature of adversity (Southwick *et al.*, 2014). It focuses on individual, contextual, and social constructs that reduce the progression of problematic behaviors, mental illness, and medical challenges (Zimmerman, 2013). Understanding psychological resilience, individuals can cope with a crisis while mentally and emotionally restoring to normalcy (Nindl *et al.*, 2019). Resiliency is apparent when individuals can utilize mental processes, emotions, and behaviors to protect themselves from the adverse effects of stress. It is the ability to examine cognitive, emotional, and social stressors related to traumatic events. Service members must be resilient to cope and deal with psychological stressors to maintain personnel readiness obligations (Nindl *et al.*, 2019).

Service members' mental health is vital, and resilience plays an integral role in assisting them in coping with stress from their duties. The World Wars, the Vietnam War, and the Persian Gulf War were the deadliest conflicts of the twentieth century (U.S. Department of Veterans Affairs [DVA], 2012); however, for two decades, the U.S. military has been combatting GWOT and resolving conflict in the Middle East (Congressional Research Service [CRS], 2019a). And as a result, "over 2 million U.S. military personnel were deployed in three million duty tours, lasting more than 30 days as part of OEF and OIF" (Institute of Medicine U.S. Committee on the Initial Assessment of Readjustment Needs of Military Personnel, Veterans, and Their Families, 2010, p. 1).

Resilience theory is a foundational principle that provides comprehensive research on the longest wars in American history, which have significantly impacted the psychological health of military service members (Lloyd, 2015; Litz, 2014; Callahan, 2010). Research has shown that the history of promoting resilience in the military is vital in mitigating risks for "serious post-traumatic negative outcomes" of those who serve in the military during the time of war (Litz, 2014, para. 1). Thus, it is a vital model and directly correlates to the military psychology specialization. Military psychology is the amalgamation of military and psychological theories focusing on clinical/counseling practices, experimental studies, human factor engineering, industrial/organizational structures, and social disciplines (Krueger, 2012). Laurence and Matthews (2012) reported that military psychology plays a crucial role in "recruiting, training, socializing, assigning, employing, deploying, motivating, rewarding, maintaining, managing, integrating, retraining, transitioning, supporting, counseling, and healing of military members" (para. 1).

Such force structure and mission readiness requirements are vital to identify the link between service members' mental health and personal readiness obligations. Krueger (2012) conveyed the importance of incorporating military psychology and resiliency theories for developing screening tests to assess active service members' aptitude and cognitive ability for personnel readiness standards. Maheshwari and Kumar (2016) discovered that military psychology principles are integral to determining the psychosocial well-being of service members in direct and indirect combat operations. Therefore, resiliency is needed to deal with the aftereffects of war (Fletcher & Sarkar, 2013).

Sinclair *et al.* (2013) emphasized how military personnel's personality and psychological resilience models are fundamental in understanding flexibility (para. 1). Resilience theory is used in this study to introduce and thoroughly explain an innovative concept, *forensic neuropsychopathology.* With these models, this study incorporates forensic neuropsychopathology as a needed mental health initiative to examine the impact of combat and trauma on different brain cortical structures in U.S. service members and how severe psychopathologies predispose them to commit violent crimes.

Significance of the study

As of 2020, the DoD has not met the required standards for mental health programs for service members (U.S. Inspector General [IG], 2020). As severe neuropsychopathologies continue to be the most significant health concern among the U.S. Armed Forces, advancing mental health initiatives in further studying neuropsychology is essential. However, though the DoD has improved neuropsychological services, there are no neuropsychopathological initiatives to examine how severe mental illnesses impact different cortical brain structures. Exploring this phenomenon is vital because of increased military discharges and violent crimes (Cesur *et al.*, 2020; Krancevich, 2020; MacQuarrie *et al.*, 2020; Giardino, 2019; Acosta *et al.*, 2014; Elbogen *et al.*, 2014). Therefore, this study examined the impact of combat exposure and trauma on different cortical brain structures in U.S. service members to determine how they are predisposed to commit violent crimes, which forces them to leave active duty.

Forensic neuropsychopathology is essential to mental health initiatives, as it further examines how mental illnesses affect different parts of the brain in a legal setting. Additionally, such challenges affect psychological and physical fitness standards for the active duty component of the Armed Forces, reducing their readiness capabilities to remain on active duty (Brignone *et al.*, 2017; DHCC, 2017). Therefore, understanding how severe neuropsychopathologies impact brain structures is significant to forensic neuropsychopathology. This discovery was pivotal in determining if service members can remain on active service, medically separate, or criminally responsible when committing violent crimes.

Results

Based on the systematic literature review approach and PRISMA model, the following research questions were explored:

RQ1. How do combat exposure and trauma change different cortical structures and brain performance?

RQ2. How can service members with severe neuropsychopathologies remain on active duty?

RQ3. What are the connections between severe neuropsychopathologies and committing violent crimes?

> ***SQ1.*** How can service members with severe neuropsychopathologies return to active duty if they are found not criminally responsible for violent crimes committed?

RQ4. How can policymakers, defense leadership, and military legal professionals work with mental health experts to develop neuropsychopathological initiatives?

This portion of the study presented findings from the literature review to answer the research and sub-questions. Specific coding techniques that covered the context of the research topic, problem, and questions were identified using NVivo and secondary analysis processes (i.e., triangulation). Also, this section identified themes, addressing primary concerns in this study and how they critically impact the neuropsychopathological initiatives of the DoD.

Participants

There were not any participants used in this study. However, participants from selected studies were drawn from much empirical and evidence-based work and analyzed for this study. The stratified random sampling method was selected to identify U.S. service members (i.e., active duty and recently discharged veterans) who served in OIF and OEF. The population was based on the number of participants involved in the evaluated data between 2006 and 2015. The size was determined by the number of combat veterans diagnosed with severe neuropsychopathologies, trauma, combat exposure, military discharges, and committed violent crimes. A total of 1.9 million service members were considered for this study. Veterans refer to individuals who have served in the U.S. military for at least three years or more. This also includes active duty service members who served in combat (i.e., combat veterans).

Of the 1.9 million potential participants, 540,520 met the criteria for this study. Of those 540,520, 64% (345, 932.8) were used in the stratified random sampling process. The participants were selected and partitioned into subpopulations based on the following characteristics: *age, criminal history, deployment record, discharge data, education, marital status, mental health history, neurological history, mental health type, service branch, race, rank, socioeconomic status, traumatic experiences,* and *years of service.*

Limited information on criminal history, deployment record, neurological history, socioeconomic status, treatment history, and years of service reduced the demographical information used in this study. In addition, the eligible U.S. service members were compartmentalized by severe neuropsychopathologies such as PTSD, anxiety, depression, TBI conditions, and other mental illnesses. Thus, the lack of information on some demographical characteristics was the only discrepancy from the data collection plan. Tables 1 and 2 show the demographics of U.S. service members.

Results: Research question one

How do combat exposure and trauma change different cortical structures and brain performance?

For research question one, 46 articles were selected, as detailed in Table 3. Common themes and patterns such *as neurocognitive deficits, combat exposure, depression, mTBI*, and *PTSD* were evaluated to analyze data and answer the research question. The articles chosen were sufficient concerning combat exposure, trauma, and cortical brain structures on cognitive performance. Of the 32 scholarly works selected, 27 (i.e., highlighted in red) directly examined how different cortical brain structures impact service members exposed to combat and trauma.

Table 3. Articles and themes for research question one – combat exposure, trauma, and cortical brain structures.

Author(s)	Themes	Subjects
Naisberg *et al.* (1995)	schizophrenia, biophysical ionic shunts, neural pathways	research
Frifth (1996)	schizophrenia, mental impairment	patients (civilians)
Cadenhead *et al.* (1998)	schizophrenia, cognitive deficits	16 patients (schizophrenic) 17 healthy parents
Taylor (1999)	neurodevelopmental disorders (i.e., ADHD), psychopathologies, genes, frontal lobe, and basal ganglia abnormalities	research
Fossanti *et al.* (2002)	neuropsychopathologies, neurocognitive, executive function deficits, frontal lobe dysfunction, psychotic features	research
Gross & Huber (2008)	schizophrenia, brain disease, brain impairment	patients
Chan *et al.* (2010)	schizophrenia, sensory integration, motor coordination, complex motor action deficits	patients
McKee *et al.* (2014)	traumatic events, cognitive functioning, mTBI, neurostructural damage, neurocognitive/ neurodegenerative disease, PTSD	research
Phillipi & Koenig (2014)	brain function, psychopathology	individuals
Harrison (2015)	brain structural changes, psychological conditions	individuals
Corbo *et al.* (2016)	chronic pain, cingulate and insular cortices, gray matter, cortical thickness (i.e., reduction/thinning), neuroimaging, combat exposure, left inferior frontal gyrus, superior parietal cortex, right rostral middle frontal gyrus, precentral and postcentral gyri, superior temporal cortex, OIF, OEF	54 military veterans
Pievsky & McGrath (2017)	Neurodevelopmental disorders (i.e., ADHD), neurocognitive domain deficits (i.e., working memory, reaction time, response inhibition, intelligence, achievement, planning, organization)	research
Wrocklage *et al.* (2017)	cortical thickness (i.e., reduction/thinning), combat exposure, PTSD, depression, neuroimaging, the prefrontal cortex. left lateral prefrontal, OIF, OEF	69 military veterans discharged
Hale *et al.* (2018)	frontal-subcortical circuit, psychopathologies, personality variations	research
DePalma & Hoffman (2018)	behavioral changes, executive dysfunction, memory loss, cognitive impairment, neurodegenerative disease, PTSD, TBI	research
Blank *et al.* (2019)	brain disorders, psychological conditions	individuals
Gradus (2019)	behavioral changes, executive dysfunction, memory loss, cognitive impairment, neurodegenerative disease, PTSD, mTBI, TBI, neurostructural damage	research
Aguilera *et al.* (2019)	combat deployments, extreme combat exposure, autonomic modulation, cortical arousal, OIF, OEF	31 male military veterans (U.S. Army) discharged

Table 3. *Continued*

Author(s)	Themes	Subjects
Forguet-Boreu *et al.* (2019)	cognitive impairment (i.e., brain structural change), cardiovascular disease, severe mental illness (i.e., bipolar, schizophrenia, schizoaffective),	60 severely mentally ill patients
Broitman *et al.* (2020)	neurodevelopmental disorders (i.e., ADHD), anxiety, depression, academic challenges	research
Betscher *et al.* (2020)	brain structures (i.e., precuneus, hippocampus, anterior cortex, anterior insula, amygdala, temporal areas) healthy patients, psychopathologies, anxiety, depression	research
Brooks *et al.* (2020)	neuropsychopathologies, neurocognitive, executive function deficits, frontal lobe dysfunction, depression	research
Rathod *et al*. (2020)	schizophrenia, sensory integration, motor coordination, complex motor action deficits	patients
Liang *et al.* (2020)	major depressive disorder, default mode networks, heterogeneity	research
Bolton *et al.* (2020)	disturbing conduct, disturbing behavior, dynamic functional connectivity, neural processing alterations, severe mental illness, neuroimaging	research
Daniels *et al.* (2020)	mitochondria, psychopathologies, stress	research
Wei *et al.* (2020)	bipolar disorder, major depressive disorder, schizophrenia, regional homogeneity (i.e., primary sensory, visual association cortices, frontal cortex, angular gyrus), leptin	728 patients (423 severe mental illness, 325 healthy)
Gong *et al.* (2020)	major depressive disorder, posterior/anterior regions, hippocampus, atypical functional connectivity	research
Cuthbert & Morris (2021)	schizophrenia, psychotic spectrum disorders, heterogeneous syndrome, genomics	patients
Kühn *et al.* (2021)	hippocampus, medial prefrontal cortex, anterior cingulate cortex, ventromedial prefrontal cortex, neural foundation, severe trauma exposure, PTSD, OIF, OEF	121 active duty service members (before and after combat deployments) 40 service members (did not deploy) active service
Kostelnik *et al.* (2021)	mTBI, PTSD, service members, neurobehavioral deficits, memory deficits	research
Weiner (2021)	traumatic events, cognitive functioning, mTBI, neurostructural damage, neurocognitive/ neurodegenerative disease, PTSD	research
Alexender & Brown (2018)	neurocognitive performance, PTSD, mTBI, behavioral/ emotional	research
Combs *et al.* (2015)	neurocognitive performance, PTSD, mTBI, behavioral/ emotional	251 combat veterans
Tate *et al.* (2021)	neurocognitive performance, PTSD, mTBI, behavioral/ emotional	combat veterans
Sullen *et al.* (2021)	neurocognitive performance, PTSD, mTBI, behavioral/ emotional	combat veterans
D'Arcy *et al.* (2020)	neurocognitive performance, PTSD, mTBI, behavioral/ emotional, fMRI	combat veterans
Dieter & Engel (2019)	neurocognitive performance, PTSD, mTBI, behavioral/ emotional, fMRI	research
McInnes *et al.* (2017)	neurocognitive performance, PTSD, mTBI, behavioral/ emotional, fMRI	research
Cardoso *et al.* (2019)	depression, mTBI, brain structural changes, neurostructural damage, frontal lobe, neurodegeneration disease	research
McKee *et al.* (2014)	depression, mTBI, brain structural changes, neurostructural damage, frontal lobe, neurodegeneration disease	research

Table 3. *Continued*

Author(s)	Themes	Subjects
Gradus (2019)	depression, mTBI, brain structural changes, neurostructural damage, frontal lobe, neurodegeneration disease	research
Vik *et al.* (2019)	depression, mTBI, brain structural changes, neurostructural damage, frontal lobe, neurodegeneration disease	research
Vasterling *et al.* (2018)	depression, mTBI, brain structural changes, neurostructural damage, frontal lobe, neurodegeneration	research
DePalma & Hoffman (2018)	depression, mTBI, brain structural changes, neurostructural damage, frontal lobe, neurodegeneration	research
Wei *et al.* (2018)	depression, mTBI, brain structural changes, neurostructural damage, frontal lobe, neurodegeneration	research

* Individuals denote persons who participated in a study.
* Research denotes studies completed but not focused on the participants, such as sociodemographic or statistical data.
* Patients denotes individuals who have been hospitalized for psychiatric treatment.
* Active denotes U.S. service members active duty veterans (i.e., combat).
* Discharge denotes U.S. service members discharged (i.e., medical, nonroutine, honorable, dishonorable).

Different brain cortical structures

Data were analyzed to answer the first research question on how service members exposed to combat and trauma-impacted different brain cortical structures. Understanding brain structures are integral to examining how severe neuropsychopathologies impact brain functions. The brain controls an individual's primary senses (i.e., cognition, sensation, movement, sight, hearing, and taste). The cortical structure is a complex system consisting of the cerebrum, cerebellum, and diencephalon and is a significant component of brain functioning.

The cerebrum is the most significant part of the brain and comprises the right and left hemispheres (i.e., the cerebral hemispheres). It is important to note that each side of the brain controls movement on the oppositive of the body; damage to the brain's left hemisphere can cause weakness on the right side and contrariwise. It is in the most anterior region of the skull. The construct is responsible for the integration of complex sensory and neural functions. It also controls the initiation and coordination of voluntary movement within the body.

The cerebrum includes the left and right cerebral hemispheres and the four lobes: frontal, temporal, parietal, and occipital. The frontal lobe is responsible for cognitive skills and controls executive functions such as decision-making, problem-solving, planning, emotional expression, memory, language, judgment, and sexual behaviors (Firat, 2019). It is the epicenter of the brain's ability to communicate. Frontal lobe deficits can impair executive functioning, affecting motivation, planning, social behavior, and language and speech production (Pirau & Lui, 2022).

The temporal lobe is the second-largest lobe of the cerebral cortex, and its purpose is to understand language, memory acquisition, face recognition, objection recognition, perception, and auditory processing information (Patel *et al.*, 2020). The hippocampus and the amygdala are located within the temporal lobe and are significant constructs for memory. The hippocampus brain structure is embedded deep within the temporal lobe and is responsible for learning and memory. The amygdala accounts for emotional regulation and links emotions to memories, reward processing, and decision-making. Damage to the temporal lobe can inhibit an individual's ability to talk and provoke challenges with memory. The left temporal lobe deficits can result in impaired memory and verbal material. The right temporal lobe can cause nonverbal impairment.

The parietal lobe processes somatosensory information (i.e., pain, temperature, touch, smell, and sight). It is responsible for integrating information into various modes related to sensory perception. Impairment or damage to the parietal lobe can cause sensory dysfunction (Ambron *et al.*, 2018). The occipital lobe interprets eye information and is responsible for different visual functions. Damage to the occipital lobe can result in visual impairment or possibly blindness.

The cerebellum is the "little brain" and manages the time and force of various muscle groups to produce fluid limb or body movements for smooth and balanced muscular activity. The construct is a significant component of motor learning behaviors and voluntary movements such as posture, balance, coordination, and speech. Damage or impairment to the cerebellum can lead to loss of coordination of motor movement (i.e., asynergia), the inability to judge distance and when to stop (i.e., dysmetria), the inability to perform rapid alternating movements (i.e., adiadochokinesia), movement tremors, and staggering (i.e., ataxic gait) (Gold & Toomey, 2018).

The diencephalon is part of the brain (i.e., the forebrain), a primary relay and processing center for sensory information and autonomic control. It is considered a communications pathway between such structures and is comprised of the epithalamus (i.e., the posterior), thalamus (i.e., the middle), and the hypothalamus (i.e., the inferior). Thus, the diencephalon interconnects with various parts of the nervous system and autonomic nervous functions.

The epithalamus is part of the forebrain, which contains the thalamus, the hypothalamus, and the pituitary gland. It maintains circadian rhythms and regulates motor pathways and emotions (Reddy *et al.*, 2021). The thalamus has extensive nerve connections to the cerebral cortex and the midbrain. It controls the cerebral cortex's relay motor and sensory signals (Thau *et al.*, 2021). Finally, the thalamus relays sensory, and motor signals, consciousness, and alert regulation (Thau *et al.*, 2021). The hypothalamus is a construct formed by the nervous fibers and a group of nuclear bodies with many functions. It links the nervous and endocrine systems, maintaining the body's homeostasis (Reddy *et al.*, 2021). Additionally, it controls the hormones responsible for the reproductive system, maternal behavior, sexual arousal, and trust (Reddy *et al.*, 2021).

The brain and neuropsychopathologies

Neuropsychology is the study of examining the brain-behavior relationship. It describes the functions of various significant brain areas to determine psychological states that impact functioning. When integrating psychopathology (i.e., neuropsychopathology), further examination is needed to understand how mental illness impacts the brain and the endocrine system's major areas. Incorporating the two concepts provides an understanding of the fundamental functioning of neurons and biological approaches to examine brain structures and the human body and what influences are attributed to severe mental illnesses. Neuroscience is also a significant constituent in providing advanced studies to examine specific brain regions that are damaged or impaired due to psychological and behavioral changes. Finally, the combination of brain behavior and mental diseases provides information on the interactions between the nervous and endocrine systems to better various changes to the cortical structures of the brain.

The brain controls the nervous system, which consists of the central nervous and peripheral nervous systems. The central nervous system (CNS) includes the brain and the spinal cord, while the peripheral nervous system is divided into two regions that control the somatic and autonomic nervous systems. The CNS processes all incoming information and determines if it is relevant to interpret sensory signals (i.e., sound, taste, touch, memory, language comprehension, etc.). If so, those responses are sent from the brain to the spinal cord. The peripheral nervous system comprises thick bundles of axons (i.e., nerves), responsible for sending messages between the CNS, muscles, organs, and senses outside the CNS (i.e., periphery).

The spinal cord provokes immediate reactions to specific stimuli (i.e., reflexes) and is the catalyst for transmitting information from the peripheral nervous system to the brain and contrariwise. The somatic nervous system sends sensory and motor signals to and from the CNS within the peripheral nervous system, a primary factor in controlling voluntary movements (i.e., muscle movement). On the contrary, the autonomic nervous system controls the organs, glands, and involuntary muscle movement (i.e., breathing, heartbeat, digestion, elimination, etc.). The autonomic nervous system is partitioned into two systems: sympathetic and parasympathetic. The sympathetic activation is predicated on energy use to maintain homeostasis (i.e., body temperature, response to threats, fight or flight, mobilization, etc.). The parasympathetic activation construct indicates functioning under normal conditions such as eating, resting, and digestion.

The endocrine system is comprised of various glands to produce hormones. Hormones are chemical messengers that must bind to a receptor to send signals. They are secreted into the bloodstream and travel throughout the body, changing any cells that contain receptors for their purpose. The endocrine system is a vital construct of the brain, especially with the hypothalamus and the pituitary gland, to regulate the functioning of other glands throughout the body. This is especially important to conceptualizing psychopathology, as glands release specific chemical messengers that impact psychological, biological, and behavioral functioning. For instance, the adrenal gland releases epinephrine (i.e., adrenaline) and cortisol (i.e., the stress hormone), while the thyroid gland processes energy metabolism and physical growth. In addition, the reproductive glands produce eggs, sperm, estrogen, and testosterone, which are vital components in impacting mood and behavior.

Hormones are produced by the endocrine systems and are significantly associated with mental illnesses. For example, reduced levels of thyroid production can imitate significant depression. Also, excessive thyroid levels can imitate mania symptoms found in bipolar disorder; as a result, individuals should have blood tests completed for further assessment and diagnostic clarification. The adrenal glands that produce cortisol are essential in the hypothalamic-pituitary-adrenocortical axis (i.e., the HPA axis). The HPA axis connects the brain and endocrine system and is central to the body's stress or threat response. It is a significant pathway of neurons that impacts an individual's flight or fight response.

Dysfunction or impairment of the HPA axis is implicated in severe mental illnesses like anxiety, depression, and PTSD. Additionally, overexposure to stressful events (i.e., death, child abuse, etc.) may cause the HPA axis to become overly sensitive (Murphy & Castel, 2023). Moreover, persistently high cortisol levels have been shown to damage the hypothalamus, forming difficulties in regulating the stress response (Petrescu *et al.*, 2018). Furthermore, prolonged cortisol levels are susceptible to anxiety and depression into adulthood and late in life.

Combat exposure

U.S. service members must meet personnel readiness standards by being mentally, physically, and spiritually fit. Such standards are based on military readiness requirements indicative of service obligations service members must meet to complete combat operations (Bricknell & Ross, 2020; DHCC, 2017; Fadum *et al.*, 2019). Service members can be discharged from military service if they do not meet standards. Due to severe neuropsychopathologies, increased military discharge can impact force structure requirements needed to sustain a ready force. As a result, U.S. national security initiatives are affected without a ready force, making the country susceptible to increased national security threats.

The OIF and OEF campaigns covered 13 years, impacting over two million service members who aided in combat and support operations (Brown University, 2021; National Academies Press, 2010). More than half of the 2.8 million who served deployed more than once, and at least 1.35 million have some medical, psychological, and physical disability (Brown University, 2021). Furthermore, since the inception of the OIF and OEF campaigns, over 40,000 have been wounded because of hostile actions, combat exposure, and TBI in which the U.S. Army has experienced the majority of such polytrauma due to its mission operations and role in military warfare (National Academies Press, 2010; Congressional Research Service, 2019b). Also, blast exposure has caused various physical and health outcomes like MDD, PTSD, and TBI.

Prolonged combat exposure and other hostile actions can lead to severe psychological impairment (Schnittker, 2018). Additionally, severe mental illnesses and polytrauma can increase readjustment and treatment challenges (Reisman, 2016). Combat veterans experience more complex and emotional trauma than any other war in the 20th century. This is due to higher survival rates because of technological advancements in weaponry, body armor, combat vehicles, and resources. Moreover, there have been increased medical responses such as combat care and aeromedical evacuation. As a result, service members affected by combat exposure are more susceptible to severe neuropsychopathologies. They also report more psychological and impaired functioning deficiencies that can significantly affect their daily lives.

Theme 1. Neurocognitive deficits

Data were analyzed for research question one to determine how combat exposure and trauma affect brain cortical structure and performance. Prolonged combat exposure and traumatic events due to deployments have significantly impacted neuropsychological functioning and structural changes (Harrison, 2015; McKee *et al.*, 2014). OIF and OEF combat veterans were examined to assess the effects of combat exposure and trauma, and the result found the brain's anterior cingulate and insular cortices were affected (Besteher *et al.*, 2022; Kühn *et al.*, 2021; Corbo *et al.*, 2016). The cingulate cortex is part of the limbic system and is responsible for processing emotions and behavioral regulation. Additionally, the cortex regulates autonomic motor functions and serves as a bilateral connection to all major lobes. The insular cortex is sensory and emotional and transports sensory signals throughout the body to receive sensory information.

Further research implicated that combat exposure and trauma were significant indicators of executive dysfunction. In addition, evidence showed that excessive stress from deployments caused impairment in execution (Gajardo-Vidal *et al.*, 2021; Alexander & Brown, 2018). The frontal lobe's primary function is communicating with other lobes to manage high-level executive functions. Additionally, the frontal lobe is part of the brain responsible for making moral choices and understanding the consequences of one's actions. Thus, executive dysfunction can reduce an individual's capacity to maintain vital mental skills.

Theme 2. PTSD

Pre-existing studies suggested that PTSD is the leading severe neuropsychopathology diagnosis among OIF and OEF combat veterans. In addition, PTSD has been linked to structural changes within the brain, especially with severe and long-term stress symptoms. Research revealed combat veterans with PTSD experienced changes within the brain's cortical thickness. Significant findings discovered an apparent reduction in cortical thickness, predominantly within the anterior prefrontal cortex region (Besteher *et al.*, 2022; Wrocklage *et al.*, 2017; Corbo *et al.*, 2016).

Cortical thickness changes were identified through fMRI scans (Wrocklage *et al.*, 2017; Corbo *et al.*, 2016). They found significant changes within the left inferior frontal gyrus, superior parietal cortex, right rostral middle frontal gyrus, precentral and postcentral gyri, and the superior temporal, which are essential to brain functioning (D'Arcy *et al.*, 2020; Corbo *et al.*, 2016). In addition, research proved that reduced cortical thickness mass could present arousal, attention, and memory challenges (Wrocklage *et al.*, 2017; Corbo *et al.*, 2016).

PTSD has been shown to impact neurocognitive and psychological conditions significantly. Evidence revealed that OIF and OEF combat veterans performed poorly on neuropsychological assessments compared to populations not diagnosed with PTSD (Tate *et al.*, 2021; Dieter *et al.*, 2019; Mattson *et al.*, 2019; Muebl *et al.*, 2018; McInnes *et al.*, 2017; Combs *et al.*, 2015). Also, they had significant cognitive decline compared to healthy controls (Tate *et al.*, 2021; Sullen *et al.*, 2021). PTSD has significantly impacted verbal memory, visual, and attention capabilities (Sullen *et al.*, 2021; Mattson *et al.*, 2019; Combs *et al.*, 2015).

Theme 3. mTBI

Evidence identified a substantial correlation between mTBI and PTSD comorbidity. Findings revealed that combat veterans diagnosed with mTBI showed a poorer neurocognitive decline than healthy controls (Cardoso *et al.*, 2019; Gradus, 2019). The predominant findings were significant memory, visual, attention, and executive dysfunction (Cardoso *et al.*, 2019; Gradus, 2019). In addition, neuroimaging showed that the frontal lobe region was predominantly impacted compared to other brain regions (Cardoso *et al.*, 2019; Gradus, 2019).

Experts purported that untreated mTBI can lead to progressive neurostructural damage, accelerating neurodegeneration within the brain (Aguilera *et al.*, 2019; Gradus, 2019; Vik *et al.*, 2019; DePalma & Hoffman, 2018; Vasterling *et al.*, 2018). Additionally, prolonged effects of mTBI can result in dementia-related diseases and severe neuropsychopathologies like PTSD and MDD (McKee *et al.*, 2014). Such issues correlate to progressive neurodegenerative diseases that significantly impair behavior, memory, attention, executive functioning, and other neurocognitive impairments (Aguilera *et al.*, 2019; Gradus, 2019; Vik *et al.*, 2019; DePalma & Hoffman, 2018; Vasterling *et al.*, 2018).

Theme 4. Depression

According to the findings, depression is the third leading diagnosis of OIF and OEF combat veterans due to combat exposure and trauma. Research implied that depression altered cortical brain structures in once-healthy service members. Findings presented a relationship between examining neurocognitive deficits and depression due to combat exposure and trauma. Depression impacts the anterior cingulate and insular cortices of the brain (Besteher *et al.*, 2022; Kühn *et al.*, 2021; Corbo *et al.*, 2016). Additionally, the precuneus and temporal areas of the DFN were affected; however, not as significant as alterations within the cortices (Besteher *et al.*, 2022; Wei *et al.*, 2020).

Like PTSD, there is a link between depression and cortical thinning, hypothesizing that heightened stress and negative somatic symptomologies can impact cortical thickness. In addition, the prolonged effects of severe neuropsychopathologies, like MDD, can produce cortical thinning in the right hemisphere, affecting one of the frontal lobes (Besteher *et al.*, 2022; Wrocklage *et al.*, 2017; Corbo *et al.*, 2016). Finally, cortical thickness could present arousal, attention, and memory challenges (Wrocklage *et al.*, 2017; Corbo *et al.*, 2016).

Discussion: Research question one

It was proven that combat exposure and trauma contribute to severe neuropsychopathologies that significantly impact the brain by examining different cortical brain structures. The cortices of the brain depend on the healthy functioning of the four lobes, which are responsible for vision, language, memory, cognitive, emotional, and perceptual functioning. All lobes can be altered by severe mental illness and brain injuries (Singh *et al.*, 2021; Henderson *et al.*, 2020). However, the research identified that PTSD, depression, and mTBI predominantly impact the frontal lobe and prefrontal cortex. For instance, research showed that OIF and OEF combat veterans with PTSD had minor impacts on measures of verbal memory, and those with mTBI had more harmful effects on processing speed and visual attention measures, which both significantly impact the frontal lobe (Sullen *et al.*, 2021; Combs *et al.*, 2015). In addition, the frontal lobe is the common region for TBI brain injury (Gajardo-Vidal *et al.*, 2021).

Additional research found that combat veterans with a history of PTSD and TBI experience behavioral and cognitive deficits, which are indicative of frontal lobe alterations (i.e., inattentiveness and memory loss) and social functioning impairment and emotional distress (Tate *et al.*, 2021; Dieter & Engel, 2019; Mattson *et al.*, 2019; Bog *et al.*, 2018; Lindquist *et al.*, 2018; McInnes *et al.*, 2017). Additionally, prefrontal cortex dysfunction causes changes in executive

function, behavioral disturbances, and emotional dysregulation (Kühn *et al.*, 2021; Nakayama *et al.*, 2015; Wrocklage *et al.*, 2017; Barrash *et al.*, 2018).

D'Arcy *et al.* (2020) reported that severe TBI injuries significantly impact motor function skills, another function that concerns the frontal lobe. This is significant because the frontal lobe is responsible for cognitive, emotional, behavioral, and motor functioning within the human body. Thus, the frontal lobe's significant or permanent impairment can damage higher functioning processes that inhibit an individual from functioning wholly or correctly in fundamental tasks (Pirau & Lui, 2022).

Cognitive deficits among combat veterans have resulted from severe trauma and brain injury (Engel *et al.*, 2019; Mattson *et al.*, 2019). For example, Engel *et al.* (2019) and Vartanian *et al.* (2020) assessed concussive brain injuries due to trauma from repeated low-level blasts that provoked severe neurocognitive deficit profiles. Furthermore, prolonged exposure to blast trauma significantly impacted neurocognitive profiles, such as a reduction in cognitive-motor integration capabilities. In addition, combat deployment history indicates an associated increased risk of PTSD and TBI. Therefore, recommendations to further explore the impact of neuropsychological initiatives for health and performance in military members are vital, as evidence indicates continued occupational performance can potentially affect higher executive functioning and lead to neuropsychopathological comorbidities.

Results: Research sub-question one

How can service members with severe neuropsychopathologies return to active duty if they are found not criminally responsible for violent crimes committed?

Only one article was reviewed for research sub-question one, detailed in Table 4. The theme of *criminal responsibility* was evaluated to establish a relationship and find possible answers to the research question. Although there was only one (i.e., highlighted in black) scholarly work to answer the sub-question, the results provided meaningful data that will be integral for improving military justice system efforts dealing with mental health cases.

Theme 1. Criminal responsibility

The prevalence of PTSD effects on brain structures has been a complex topic to examine possible permanent or irreversible damage to the brain. There is insufficient data to determine if the prolonged effects of PTSD are considered a mental health disability that questions an individual's competency and sanity. Umbrasas (2020) conducted a study to determine if PTSD can be considered an insanity defense for service members who commit violent crimes. The study was crucial in determining if service members' competency was impacted to stand trial.

Findings showed that PTSD was deemed a severe neuropsychopathology and is substantial for legal teams to enter a "mental disease or defect" defense for their clients (Umbrasas, 2020). Additionally, PTSD was assessed to determine how sanity boards handle military criminal cases. Evidence found that 13% of the military members evaluated were diagnosed with PTSD (Umbrasas, 2020). Though the service members did not meet the criteria for incompetency to stand trial, 30% met severe mental disease or defect (Umbrasas, 2020). Therefore, evidence revealed that PTSD is a severe mental illness, and long-term effects can mitigate an individual's criminal responsibility.

Discussion: Research sub-question one

There is insufficient data to determine if severe neuropsychopathologies can mitigate the criminal responsibility of committing violent crimes. Though evidence shows that severe neuropsychopathologies like PTSD can cause mental disease or defect cases, additional research is required. Furthermore, more research is needed to determine if the

Table 4. Articles for research sub-question one – severe neuropsychopathologies, active service, and violent crimes.

Author	Themes	Subjects
Umbrasas (2020)	criminal responsibility, trial, PTSD, OIF, OEF, competency/insanity evaluations	active duty service members

* Individuals denote persons who participated in a study.
* Research denotes studies completed but not focused on the participants, such as sociodemographic or statistical data.
* Patients denotes individuals who have been hospitalized for psychiatric treatment.
* Active denotes U.S. service members active duty veterans (i.e., combat).
* Discharge denotes U.S. service members discharged (i.e., medical, non-routine, honorable, dishonorable).

prolonged effects of other neuropsychopathologies like GAD, MDD, and TBIs can influence criminal responsibility for service members.

Results: Research question two

How can service members with severe neuropsychopathologies remain on active duty?

For research question two, eight journals were selected (i.e., highlighted in grey), detailed in Table 5. Common themes and patterns, such as *personnel readiness* and *military discharges,* were evaluated to establish a relationship and find possible answers to the research question. The articles chosen were essential in exploring how combat veterans with neuropsychopathological conditions can remain on active duty. Of the eight scholarly works selected, all articles predicted future outcomes for active duty service member obligations. However, three scholarly works (i.e., highlighted in red) focused on neuropsychopathological conditions).

Theme 1. Personnel readiness

U.S. service members with severe neuropsychopathological conditions are not fit for duty, and the chances of remaining active service are significantly reduced. Because prolonged effects of combat exposure, trauma, and brain injuries can alter cortical structures of the brain, particularly the frontal lobe, higher executive functions are substantially impacted. Service members with frontal lobe deficits would experience challenges with cognitive, behavioral, and emotional capabilities (i.e., mood and emotional dysregulation). Additionally, severe impairments such as cognitive-motor integration and movements could substantially reduce a service member's ability to function and complete military mission obligations physically.

Because of the seriousness of neuropsychopathological conditions, medical and non-routine military discharges have been general discharge processes for service members. However, the "fit to fight" mantra requires that service members meet all mental and physical health requirements (DHCC, 2017). Therefore, the Medical Evaluation Board (MEB) was created to examine medical and mental health cases and determine if service members meet retention standards for their occupational specialties (Military Health System [MHS], 2021). If it is found that service members do not meet such requirements, their cases are referred to the Physical Evaluation Board (PEB), which is unique to the service branch.

Table 5. Articles for research question two – severe neuropsychopathologies and active service.

Author	Themes	Subjects
Brignone *et al.* (2017)	mental illness, substance abuse disorders, non-routine discharge, predisposition to incarceration, homelessness, and suicidality, OIF, OEF	443, 360 active duty service members
Barr *et al.* (2018)	non-honorable discharge, mental health issues, psychiatric concerns, suicidality, PTSD, depression, alcohol use, punitive offenses, misconduct	722 veterans (honorably and dishonorably discharged)
Holliday & Pedersen (2017)	military discharge (i.e., honorable and dishonorable), misconduct, punitive offenses, administration infractions, mental health, substance use, behavior	research
Seamone *et al.* (2017)	misconduct, stress, combat deployments, military discharge, mental illness, behavior	research
Detweiler *et al.* (2017)	military readiness, personnel readiness, mental/physical/spiritual health, military service obligations	research
Smith (2020)	personnel readiness, military discharge, anxiety, depression, sociodemographic variables	85 military discharged trainees
Dean (2021)	military discharge, intellectual disability, personality disorders	31,000 military veterans
Curtis *et al.* (2021)	violent behavior, neurocognitive impairment, substance abuse, violent offending	190 individuals

* Individuals denote persons who participated in a study.
* Research denotes studies completed but not focused on the participants, such as sociodemographic or statistical data.
* Patients denotes individuals who have been hospitalized for psychiatric treatment.
* Active denotes U.S. service members active duty veterans (i.e., combat).
* Discharge denotes U.S. service members discharged (i.e., medical, non-routine, honorable, dishonorable).

The DoD established the PEB to assess service members' medical and mental health conditions (MHS, 2021). PEBs are administrative committees determining whether a service member's medical and psychological condition prevents them from remaining on active service. In addition, the PEB determines the following: "eligibility for disability compensation, disability codes and percentage rating, disposition of service member's case, and whether an injury is combat-related" (MHS, 2021, para. 3). Before the final decision, service members have the right to advocate for themselves by reviewing the Board's information and officially responding to support or negate the decision (MHS, 2021). However, if PEB determines that a service member is unfit for service, discharge is inevitable. To be found unfit, service members must have a significant medical condition that disqualifies them from service in which they cannot perform their rank and responsibilities.

Theme 2. Military discharges

To be discharged from military obligations, service members must present severe mental health conditions impairing their ability to complete the mission. Research suggested that severe neuropsychopathologies, alcohol, and substance abuse were significant factors of non-routine discharges from continued service (Fidelisa *et al.*, 2021; Barbarach, 2021; Blais *et al.*, 2020; Barr *et al.*, 2018; Short *et al.*, 2018; Holliday & Pedersen, 2017). Additionally, conduct issues due to severe neuropsychopathologies were indicators of non-routine military discharges (Brignone *et al.*, 2018; Brignone *et al.*, 2017; Holliday & Pedersen, 2017; Seamone *et al.*, 2017).

Discussion: Research question two

No data was found to determine if service members with severe neuropsychopathologies can remain on active duty. Because severe neuropsychopathologies alter brain cortical structures, service members face significant psychological impairment and brain function deficits that can impact their ability to complete military service obligations. Research suggested that service members with significant medical conditions and severe neuropsychopathologies have been discharged under medical and non-routine statuses as they are deemed unfit for duty (Brignone *et al.*, 2018; Brignone *et al.*, 2017; Holliday & Pedersen, 2017; Seamone *et al.*, 2017).

Additionally, findings revealed that misconduct, substance, and alcohol abuse, and behavioral problems were highest in military discharges than medical exemptions. Service members who experienced punitive actions and were diagnosed with severe neuropsychopathologies were the highest military discharge rates (Fidelisa *et al.*, 2021; Brignone *et al.*, 2018; Brignone *et al.*, 2017; Holliday & Pedersen, 2017; Seamone *et al.*, 2017). Therefore, results showed that service members could not remain on active duty with severe neuropsychopathological conditions.

Results: Research question three

What are the connections between severe neuropsychopathologies and committing violent crimes?

For research question three, 25 articles were examined, detailed in Table 6. However, seven (i.e., highlighted in black) were deemed relevant to answer the research question. Common themes and patterns such as *combat veterans*, *depression*, *PTSD*, and *violent crimes* were evaluated to establish a relationship and find possible answers to the research question. Seventeen of the selected scholarly articles provided significant data to examine the relationship between severe

Table 6. Articles for research question three – severe neuropsychopathologies and violent crimes.

Author	Themes	Subjects
Sreenivasan *et al.* (2013)	violent crimes, OIF, OEF, post-deployment violence, PTSD, TBI, combat exposure, combat veterans	research
MacManus (2015)	violent crimes, mental illness, service members	research
Rosellini (2015)	violent crimes, mental illness, service members	research
Stone (2015)	violent crimes, mental illness, service members	research
Brooke & Gau (2018)	violent crimes, alcohol risks, substance abuse, neuropsychopathologies, criminal justice involvement	research
Schwartz (2018)	criminal persistence, neuropsychopathological deficits, TBI, violent offending, arrests, violent crimes	1,336 individuals

Table 6. *Continued*

Author	Themes	Subjects
Short *et al.* (2018)	violent crimes, interpersonal violence, motor offenses, GAD, PTSD, alcohol abuse, nonviolent offending, ADHD, schizophrenia	62,397 military veterans
Schnittker (2018)	violent crimes, OIF, direct/indirect killings, PTSD	research
Koenig *et al.* (2019)	violent crimes, OIF, direct/indirect killings, PTSD, substance abuse, mood disorders	2,797 combat veterans (OIF)
Giardino (2019)	violent crimes, combat veterans, mental health conditions	research
Van (2020)	violent crimes, mental illness, competency/insanity evaluations	research
Lamberti *et al.* (2020)	violent crimes, criminal behavior, mental illness (i.e., psychosis, bipolar disorder)	43 criminals
Cesur *et al.* (2020)	violent crimes, severe neuropsychopathologies, service members	research
Krancevich (2020)	violent crimes, domestic homicides, combat veterans, PTSD, stress, service members	research
MacQuarrie *et al.* (2020)	violent crimes, domestic homicides, PTSD	research
Kumar *et al.* (2021)	violent crimes, criminal cases, psychological tests, and assessments	research

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neuropsychopathological diagnosis and predisposition to committing violent crimes among service members exposed to combat and trauma.

Theme 1. Combat veterans

U.S. Army personnel were the leading service department to deploy supporting OIF and OEF campaigns. Approximately 67% of the U.S. Armed Forces deployed to both combat regions were U.S. Army soldiers (Bonds *et al.*, 2010). An estimated 289,000 soldiers utilized VA health care for the first time. Over one-third were diagnosed with severe neuropsychopathologies related to psychosocial and behavioral problems following OIF and OEF campaigns (Bonds *et al.*, 2010). Four years after the campaigns, the prevalence of severe mental illnesses significantly increased. PTSD and depression were the leading severe neuropsychopathologies identified by combat veterans who served in OIF and OEF campaigns (Krancevich, 2020; Giardino, 2019; Sreenivasan *et al.*, 2013).

Male Army soldiers were 62% of the population to receive non-routine discharges for misconduct. Approximately 60 % were white, while black males followed at 24 percent. The average age was 26.7 years, and 94% had no education beyond high school. Nearly 70% of males were never married, and 98% were enlisted. Army women accounted for 45% of non-routine discharges for misconduct and behavioral issues (VHA, 2015). The average age was 26.7 years, and nearly 92% only had a high school education. White females were the leading population at 45% for non-routine discharges, and black females followed by 39 percent. About 68% were never married, and 96% of the discharged service members were enlisted.

Theme 2. PTSD

PTSD diagnosis led to severe neuropsychopathology among combat veterans who served in OIF and OEF campaigns. It was the primary severe neuropsychopathology of those who committed violent crimes while on active duty (Smith, 2020; Brignone *et al.*, 2017). Additionally, combat veterans with PTSD were at higher risk for committing violent crimes with increased mortality rates (Giesinger *et al.*, 2020; Hamwey *et al.*, 2020). Research revealed a significant correlation between PTSD and mTBI comorbidity. Approximately 80% of combat veterans discharged from active service diagnosed with mTBI had at least one psychiatric condition, predominantly PTSD (National Academies of the Sciences, 2018; Vasterling *et al.*, 2018).

The combination and PTSD and mTBI diagnoses are linked to significant neurocognitive decline. Evidenced showed that combat veterans with both brain injury and psychiatric conditions had verbal memory dysfunction, reduced attention capacity, higher stress levels, poor sleep quality, emotional distress, and harmful effects on cognitive processing speed and visual attention measures (Sullen *et al.*, 2021; Tate *et al.*, 2021; Dieter & Engel, 2019; Mattson *et al.*, 2019; McInnes *et al.*, 2017; Combs *et al.*, 2015).

Theme 3. Depression

Following mTBI, depression was another significant factor among combat veteran diagnoses. Over one-third of the 80% diagnosed with mTBI and PTSD comorbidity were diagnosed with depression with an increased risk of suicidal ideation or attempt (MacQuarrie *et al.*, 2020; Giardino, 2019; Ribeiro *et al.*, 2018). In addition, the prevalence of PTSD and depression comorbidity was considerable, and the leading diagnoses in combat veterans predisposed to committing violent crimes (Krancevich, 2020; MacQuarrie *et al.*, 2020; Giardino, 2019; Sreenivasan *et al.*, 2013).

Depression significantly impacts the brain, as chronic symptoms can alter brain structures. The research found that individuals diagnosed with depression significantly impact executive function, and severe depression can lead to melancholic or psychotic features (Brooks *et al.*, 2020; Barr *et al.*, 2018). Evidenced showed that MDD or other chronic depressive symptoms substantially affected the frontal lobe and prefrontal cortex of the brain, impacting service members' ability to reason and make moral choices (Gajardo-Vidal *et al.*, 2021; Abhang *et al.*, 2016; Garrigan *et al.*, 2018; Garrigan *et al.*, 2016). Additionally, depression diagnoses can lead to personality changes and significant behavioral and emotional dysregulation. Furthermore, combat veterans diagnosed with depression suffered adverse effects immediately following OIF and OEF campaigns (Barbarach, 2021; Bog *et al.*, 2018; Lindquist *et al.*, 2018).

Theme 4. Violent crimes

Service members with severe neuropsychopathologies have been predisposed to committing violent crimes. For example, combat veterans who served in the OIF and OEF campaigns were the leading service members discharged for honorable, dishonorable, routine, or non-routine between 2005 and 2016 (Smith, 2020; Brignone *et al.*, 2017; U.S. Department of Veterans Health Administration [VHA], 2015). Most non-routine discharges were due to misconduct, punitive penalties, or administrative actions, while dishonorable were associated with violent crimes and other serious offenses (Cesur *et al.*, 2020; Krancevich, 2020). Most importantly, there is a link between increased violent crimes and military discharges by active service members negatively impacting national security initiatives (Cesur *et al.*, 2020; Krancevich, 2020; MacQuarrie *et al.*, 2020; Giardino, 2019; Acosta *et al.*, 2014; Elbogen *et al.*, 2014).

Numerous studies confirmed that service members who committed violent crimes were diagnosed with PTSD, other stress-related conditions, mTBI, and depression (Cesur *et al.*, 2020; Krancevich, 2020; MacQuarrie *et al.*, 2020; Giardino, 2019; Schnittker, 2018; Sreenivasan *et al.*, 2013). Additionally, various studies demonstrated that violent crimes such as indirect and direct killings, domestic homicides, and substance and alcohol abuse are the primary felonious acts committed by OIF and OEF service veterans.

Discussion: Research question three

Multiple research studies identified that OIF and OEF campaigns were American history's most prolific international conflict. Over 2.8 million service members served to protect and defend the Constitution of the United States (Brown University, 2021). Of the nearly three million, over 50% of them were diagnosed with at least one mental health condition that significantly impacted their abilities to complete military service obligations (Armed Forces Health Surveillance Branch [AFHSB], 2017).

The Department of the Army had the most service members to deploy, supporting OIF and OEF campaigns. Additionally, the service branch had the most personnel to serve in combat operations. The Army returned from both campaigns and had the most service members diagnosed with severe neuropsychopathologies, predominantly PTSD and depression. The increase in severe neuropsychopathologies led to an exponential surge in misconduct and violent crimes. In addition, such issues led to increased non-routine discharges, identifying a significant relationship between severe neuropsychopathologies (i.e., PTSD and depression), violent crimes, and discharges.

Combat exposure and trauma were the catalysts for severe neuropsychopathologies diagnoses among OIF and OEF veterans. In addition to increased mental illness diagnoses, there was a significant upsurge in violent crimes. Research suggests severe neuropsychopathologies predisposed individuals to commit violent crimes (Koenig *et al.*, 2019; Schnittker, 2018; Sreenivasan *et al.*, 2013). OIF and OEF service members who committed violent crimes were diagnosed with PTSD, other stress-related disorders, anxiety, and depression.

Table 7. Articles for research question four – policymakers, defense leadership, military leadership, mental health, and neuropsychopathological initiatives.

Author(s)	Themes	Subjects
Jaffee & Martin (2020)	initiatives, policymakers, mental health, leadership, legal	service members, veterans
Connell (2019)	forensic psychology, legal, military courts	service members, veterans
Tanielian *et al.* (2017)	initiatives, policymakers, legal, mental health, leadership	service members, veterans
Defense and Veterans Brain Information Center (2019)	initiatives, leaders, mental health, brain injuries, legal, TBI	service members, veterans

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* Patients denotes individuals who have been hospitalized for psychiatric treatment.
* Active denotes U.S. service members active duty veterans (i.e., combat).
* Discharge denotes U.S. service members discharged (i.e., medical, non-routine, honorable, dishonorable).

Results: Research question four

How can policymakers, defense leadership, and military legal professionals work with mental health experts to develop neuropsychopathological initiatives?

Four articles (i.e., highlighted in brown) were examined for research question four, and all journals were selected, detailed in Table 7. Common themes and patterns such as *forensic psychology, initiatives,* and *military justice* were evaluated to establish a relationship and find possible answers to the research question.

Theme 1. Forensic psychology

Research revealed that forensic psychologists are emerging within the military justice system to understand better the relationship between the military, law, and crime (Congressional Research Service, 2020b; Rocchio, 2020; Congressional Research Service, 2019a). Forensic psychology's influence on the civilian sector has shown that the field provides clinical approaches to rehabilitate or improve the standards of individuals involved in legal matters and has innovatively incorporated the importance of understanding how the law applies to psychology. Assisting legal professionals and law enforcement to examine human behavior and the relationship between trauma and severe neuropsychopathologies is paramount to legal decision-making processes (Joint Service Committee on Military Justice, 2020; Rocchio, 2020; Congressional Research Service, 2019a).

Evidence indicates that military neuropsychology plays a vital role in the military justice system. Providing military legal teams with resources for enhancing treatment and rehabilitative programs while reducing recidivism rates is vital in modernizing military laws (Belanger, 2020; Green *et al.*, 2017). Additionally, findings established the importance of incorporating forensic professionals within the military healthcare system to provide clinical approaches and scientific studies on how severe neuropsychopathologies relate to service-connected disabilities (Belanger, 2020; Green *et al.*, 2017).

Theme 2. Initiatives

Though the forensic psychology field continues to emerge, it has significantly influenced the civilian criminal justice system. Public service psychologists are vital in providing competent information to guide legal proceedings, from decision-making in family cases to competency evaluations to stand trial. Also, forensic psychologists work on child abuse cases, sanity hearings, and the commission of minor or severe crimes. Furthermore, these professionals can provide risk and threat assessments in the security industry. Forensic psychologists are not deduced to only clinical analysis and court proceedings; they work with social and experimental psychologists to assist legal teams as consultants.

Over the past 20 years, there has been a significant increase in support for service members and veterans who served in combat deployments, particularly the OIF and OEF campaigns. Today, forensic psychologists assist law enforcement with training first responders on how to work with service members returning from deployments (American Psychological Association, 2021). In addition, the increase in severe neuropsychopathologies has compelled government

and nongovernment (NGOs) sectors to work together to improve mental health initiatives. For example, in 2008, the Welcome Back Veterans (WBV) initiative was established by the Major Baseball League (MBL) and the Robert R. McCormick Foundation to improve mental healthcare services for military personnel and veterans. Two years later, the McCormick Foundation contracted the RAND Corporation to conduct research operations to maintain its statistical data of operational services.

Over the last decade, the WBV initiative has provided nearly 1,000 military personnel, over 3,700 veterans, and 900 reserve and guard members with mental health services (Tanielian *et al.*, 2017). In addition, the initiative has provided evidence-based therapeutic interventions for service members and nonmedical evidence-based services for their families. Additionally, their services have established a supplemental initiative to work with the DoD and the Department of Veterans Affairs (DVA). Finally, they provide diverse mental health professionals to expand competent services to military personnel and veterans.

Congress

In 2007, Congress enacted the Psychological Health and Traumatic Brain Injury Research Program (PH/TBIRP) due to the significant increase in mental health conditions, TBIs, and PTSD of combat veterans due to OIF and OEF (U.S. Department of Defense, 2021). The program procured $300 million in funding through the Congressionally Directed Medical Research Program (CDMRP) to conduct further research on TBI, resolve psychological health (PH) issues and PTSD diagnoses to improve the military healthcare system.

Between fiscal years 2009 and 2020, Congress modified the program by assigning PH/TBIRP to the U.S. Army Medical Research and Development Command (USAMRDC) to provide strategic oversight of Army programs because it better aligned with the Office of the Assistant Secretary of Defense for Health Affairs (OASD (HA). OSAD (HA) manages all DHA's research and development projects. In addition, the agency was mandated to further research interests in the following Joint Program Committee (JPC) areas:

- Joint Program Committee-5/Military Operational Medicine Research Program (JPC-5/MOMRP)
- Joint Program Committee-6/Combat Casualty Care Research Program (JPC-6/CCCRP)
- Joint Program Committee-8/Clinical and Rehabilitative Medicine Research Program (JPC-8/CRMRP) (DoD, 2021, para. 3).

The JPCs send proposals to the DHA RDA to identify research gaps, focus areas, and funding opportunities for the PH/TBIRP.

The White House and DARPA

In 2013, the White House publicized the Brain Research Through Advancing Innovative Technologies (BRAIN) initiative, a federal program that works with academic institutions, scientists, technology firms, and neuroscience experts. Created by DARPA, the BRAIN initiative works with the public and private sectors to continue advanced neurotechnology research. The initiative is responsible for the following programs: electrical prescriptions, hand proprioception and touch interfaces, neural engineering system design, Neuro Function, Activity Structure and Technology (Neuro-FAST), next-generation nonsurgical neurotechnology, restoring active memory (RAM), restoring active memory – replay (RAM Replay), revolutionizing prosthetics, systems-based neurotechnology for emerging therapies, and targeted neuroplasticity training (TNT).

The BRAIN initiative was created to increase understanding of the human brain and accelerate the development and application of innovative technologies that focus on how organisms' cells and neural circuits interact in time and space. With this initiative, DARPA and its counterparts seek new ways to prevent, cure, and treat brain disorders (National Institutes of Health, n.d.).

Military initiatives

In 1992, the Defense and Veterans Head Injury Program (DVHIP) was established to modernize research initiatives and educational programs to assist service members and veterans diagnosed with TBIs. This organization conducted extensive research to discover breakthroughs in TBI and brain injury screening, prevention, and treatment methods (Jaffee & Martin, 2010). Now known as the Defense and Veterans Brain Injury Center (DVBIC), the agency is responsible for promoting advanced TBI care from "point-of-injury to reintegration for service members, veterans,

and their families" (DVBIC, n.d., para. 2). Also, DVBIC works with the Defense Health Agency to maintain a "medically ready" force with the U.S. Armed Forces (DVBIC, n.d., para. 2).

Department of defense

In 2015, the DoD established the Comprehensive Policy on Traumatic Brian Injury-Related Neurocognitive Assessments by the Military Services. According to the agency, the purpose of the policy is to "establish policy, assign responsibilities, and prescribe standards elements, pursuant under section 722 of Public Law 111-383 (Reference (c)), requiring the implementation of a comprehensive neurocognitive assessment in the military services (2017, p. 1). All military services (including the Reserve and the Guard) and defense civilians adhere to the policy, the fundamental framework for the DoD's Neurocognitive Assessment Program. In part of the DoD's Neurocognitive Assessment Program, the ANAM is the DoD-designated neurocognitive assessment tool used to detect speed, memory, the accuracy of attention, and cognitive abilities.

Theme 3. Military justice

The military judicial system is distinctively different than the civilian legal system. As a result, there are challenges for civilian psychologists in understanding military law due to an increase in violent crimes, misconduct, and non-routine discharges. Thus, forensic psychologists must work with military legal professionals to improve court system practices. However, there have been significant changes in effectively communicating with military governing authorities and military judges to ensure fair trials. According to Connell (2019), emerging research in forensic psychology shows that psychological concepts and scientific principles apply to criminal cases, especially in military settings. However, ineffective communication has reduced information-sharing and educational assistance to improve military legal practices.

The American Psychological Association created resources to educate psychologists on legal teams better and how to work with attorneys to determine how their efforts will be conducive to the military justice system (Connell, 2019). *The Forensic Psychologist in the Military: Background, Structure, and Process* established an initiative with educators, forensic psychologists, military judges, and legal leadership to rectify this issue. Understanding how the military justice system works and the professionals involved is vital to improving fair trial processes.

Discussion: Research question four

Following OIF and OEF campaigns, policymakers have established legislative initiatives, such as WBV, in response to increased mental health illnesses. Politicians have provided resources to establish research programs to conduct evidence-based studies in improving mental health initiatives for service members and veterans. Additionally, Congress established PH/TBIRP to advance further studies focused on brain injuries and disorders. The White House worked with DARPA, one of the leading research agencies in the United States, to collaborate with private and public sector companies to advance neurotechnology programs in the military to cure, treat, and prevent brain disorders.

In the late 20th century, the military focused on mental health programs to improve psychiatric conditions. Moreover, the DoD and DVA established the DVHIP program to further research the effects of TBI and other brain injuries and disorders. Revolutionizing its name and mission, DVBIC continues to adhere to policies that mandate advanced research in neurology, neuropsychology, neuroscience, and neurotechnology.

The American Psychological Association established *The Forensic Psychologist in the Military: Background, Structure, and Process* under the American Psychology-Law Society so forensic psychologists can work with military legal experts and leaders in the military justice system to improve communication, information-sharing process, and methods of how to apply forensic psychology in a legal setting. Finally, the research identified an innovative program created by the United States' largest service branch to provide demographical information on its soldiers. The importance of the database is to identify risk factors that could predispose service members to negative actions and behaviors that could impact their personnel and combat readiness standards.

Summary

Chapter Four analyzed the data collected from the literature review to answer the research and sub-questions. Research revealed that PTSD, mTBI, and depression comorbidity were the leading severe neuropsychopathologies among combat veterans who served in OIF and OEF campaigns. Also, data identified PTSD, mTBI, and depression comorbidity significantly impacted the brain's frontal lobe and prefrontal cortex, causing symptomologies to impact their abilities to complete active duty service requirements. While there was no data to determine whether service members diagnosed with severe neuropsychopathologies can remain on active duty, studies showed increased non-routine discharges due to misconduct, violent crimes, and substance abuse.

Evidence-based studies suggested that PTSD, mTBI, and depression comorbidity were the primary severe neuropsychopathologies identified in combat veterans. Severe neuropsychopathological diagnoses among service members who served in combat campaigns have committed violent crimes. Violent crimes, misconduct, punitive actions, and substance abuse were the primary reasons for non-routine discharges. However, there was insufficient research to determine how many service members were incarcerated for violent crimes on active duty.

Additionally, there was limited information to determine how forensic psychology plays a role in these cases. In some cases, service members diagnosed with PTSD were not criminally liable for their offenses due to mental disease or defect. Thus, a lack of forensic psychological practices within the military justice system may hinder military processes that mandate that the U.S. Armed Forces be a mentally, physically, and spiritually fit force to protect the United States national security.

Discussion

Evidence has shown that combat exposure and trauma can lead to severe neuropsychopathologies. Also, research revealed prolonged effects could alter various brain structures. For example, changes within the cortices of the brain can impact cognition, emotional, and behavioral capabilities. Such dysfunction can impede service members' decision-making, rational thinking, and other higher functions jeopardizing their ability to complete military service obligations. Therefore, military service members exposed to combat and traumatic events are at higher risk for severe neuropsychopathological diagnosis, potentially having long-term effects on the brain.

This systematic literature review explored the impact of combat exposure and trauma on different cortical brain structures of combat veterans with severe neuropsychopathologies. Additionally, the study examined how these conditions predispose service members to commit violent crimes. Exploring the association between the brain and neuropsychopathologies was vital due to increased mental health diagnoses and discharges from active service following deployment campaigns (U.S. Department of Veterans Affairs, n.d., para. 1). Additionally, the aftermath of deployments and mental diagnoses have been responsible for the proliferation of violent crimes committed by service members (Krancevich, 2020; MacQuarrie *et al.*, 2020; Giardino, 2019; Sreenivasan *et al.*, 2013).

Resilience theory was used to establish the theoretical framework. Norman Garmezy is the founder of resilient concepts and has contributed significant research using models that have impacted work in military psychology. Resilience theory examines how individuals recover from an adverse situation. It is the ability to explore cognitive, emotional, and social stressors related to traumatic events. The resilience theory has foundational principles that provide comprehensive research on the longest wars in American history, impacting service members' mental health. Research has provided that promoting resilience in the military is vital in mitigating risks for post-traumatic severe adverse outcomes of service members during the war.

This study utilized the PRISMA model, examining historical studies and existing literature to conceptualize neuropsychopathologies. Hence, it has been shown that severe neuropsychopathologies result from combat exposure and traumatic events due to OIF and OEF campaigns. Thus, studies found that PTSD, mTBI, and depression comorbidity were the primary neuropsychopathologies that predisposed service members to commit violent crimes.

Discussion of findings

The findings from this research study can significantly improve the advanced neuropsychopathological initiatives for further diagnostic clarification and better treatment options for service members. Evidence revealed from this project provides specific recommendations for the professional practice of forensic neuropsychopathology as an emerging field in clinical neuropsychology; additionally, the findings presented critical data essential for further clinical studies that would provide more data on how alteration of cortical brain structures through neuroimaging. It is also needed so legal teams, leadership, policymakers, mental healthcare, and forensic professionals in the military can enhance military justice system practices.

Research question one

How do combat exposure and trauma change the brain's cortical structures and performance?

Long-term exposure to combat and traumatic events can cause neurocognitive deficits (Gajardo-Vidal *et al.*, 2021; Alexander & Brown, 2018; Harrison, 2015; McKee *et al.*, 2014). The frontal lobe and prefrontal cortex are the primary constructs impacted by neurocognitive deficits. The frontal lobe is the largest lobe within the brain and is responsible for behavioral and emotional regulation. Additionally, the lobe can disrupt high-level problem-solving capabilities, memory, judgment, and arousal behaviors.

The prefrontal cortex is located within the frontal lobe and is responsible for personality development, cognition, and actions. The effects of stress and trauma can alter brain structures that interrupt or impairs emotional and behavioral regulation. Additionally, such dysfunction impairs motor and sensory capabilities. Damage to the frontal lobe can lead to mood dysfunction, personality changes, attention and concentration difficulties, and impulsivity. Prefrontal cortex injury can result in severe emotional instability, aggressive behavior, irritability, and poor work/academic performance.

The frontal lobe is part of the brain region responsible for making moral decisions and understanding the consequences of such actions, which is a significant component in military service. Frontal lobe dysfunction can result in personality changes, inattentiveness, focus, planning, increased impulsivity levels and hindered rationalization. Therefore, a frontal lobe injury can distort or cause difficulty communicating and performing cognitive tasks (Gajardo-Vidal *et al.*, 2021; Garrigan *et al.*, 2016, 2018). Such deficiencies would significantly impact service members' abilities to complete military service obligations, reducing the chances of military service members remaining on active duty.

PTSD is the leading severe neuropsychopathological condition among OIF and OEF combat veterans. Various research studies have shown that severe and long-term symptomologies have caused cortical thinning, primarily in the anterior prefrontal cortex region (Besteher *et al.*, 2022; Wrocklage *et al.*, 2017; Corbo *et al.*, 2016). Cortical thickness reduction increases the risk of attention and memory dysfunction. Additionally, PTSD has been linked to significant neurocognitive impairment. Data analyzed showed that OIF and OEF combat veterans experienced a significant cognitive decline compared to those not diagnosed with PTSD. Furthermore, veterans experienced an apparent decline in verbal memory, attention, and visual capabilities.

A causal relationship has been identified between mTBI and PTSD comorbidity throughout the scientific and medical literature. The link between both has identified an increased risk for cognitive decline and progressive neurodegenerative diseases (Besteher *et al.*, 2020; Cardoso *et al.*, 2019; DePalma & Hoffman, 2018; Gradus *et al.*, 2019; Wei *et al.*, 2018; Vasterling *et al.*, 2018; Vik *et al.*, 2019; Wrocklage *et al.*, 2017; Corbo *et al.*, 2016; McKee *et al.*, 2014). Such risks can cause behavior, memory, attention, visual, and executive deficits.

Sub-question one

How can service members with severe neuropsychopathologies return to active duty if they are found not criminally responsible for violent crimes committed?

Findings showed that PTSD was deemed a severe neuropsychopathological condition and is legally significant to enter a "mental disease or defect" defense (Umbrasas, 2020). Additionally, PTSD was assessed to determine how sanity boards handle military criminal cases. Evidence found that 13% of the military members evaluated were diagnosed with PTSD (Umbrasas, 2020). Though the service members did not meet the criteria for incompetency to stand trial, 30% met severe mental disease or defect (Umbrasas, 2020). Therefore, evidence revealed that PTSD is a severe mental illness, and long-term effects can mitigate an individual's criminal responsibility.

There was insufficient data to determine if combat veterans can remain on active duty if they commit crimes due to severe neuropsychopathological diagnoses. Though evidence shows that severe neuropsychopathologies like PTSD can establish mental disease or defect cases, additional research is required. Furthermore, more research is needed to determine if the prolonged effects of other neuropsychopathologies like GAD, MDD, and TBIs can influence criminal responsibility for service members.

Research question two

How can service members with severe neuropsychopathologies remain on active duty?

DoD enacted policies that mandate that the U.S. Armed Forces must be medically, physically, emotionally, and spiritually fit to remain on active duty service (DHCC, 2017). Severe neuropsychopathologies are chronic mental health conditions that can prevent service members from preserving their psychological health, increasing their chances of military separation. Combat exposure and trauma are adverse effects of deployments that have been significant factors in severe neuropsychopathological diagnoses among 50% of the combat veterans who returned from OIF and OEF between 2005 and 2016.

Medical and nonmedical (i.e., non-routine) discharges for service members diagnosed with severe neuropsychopathological conditions have been the general process. Research indicated that severe neuropsychopathologies, alcohol, and substance abuse were significant factors in non-routine discharges from active service (Fidelisa *et al.*, 2021; Barbarach, 2021; Blais *et al.*, 2020; Barr *et al.*, 2018; Short *et al.*, 2018; Holliday & Pedersen, 2017). Additionally, conduct issues due

to severe neuropsychopathologies were indicators of non-routine military discharges (Brignone *et al.*, 2018; Brignone *et al.*, 2017; Holliday & Pedersen, 2017; Seamone *et al.*, 2017).

Although it can be deduced that service members with severe neuropsychopathologies are not fit for duty, there is insufficient evidence to determine if they can remain on active duty. Research supported that severe neuropsychopathologies alter brain cortical structures, leading to possible cognitive impairment and brain function deficits impacting service members' ability to complete military service obligations. The MEB examines medical and mental health evaluations to determine if service members meet duty requirements. If service members do not meet such standards, their cases are transferred to the PEB, which assesses medical and psychological health requirements based on the respective service department policies (MHS, 2021). Discharges are formal separation processes, and service members who do not meet personnel readiness standards due to mental health conditions are relieved of their military responsibilities.

Research question three

What are the connections between severe neuropsychopathologies and committing violent crimes?

The Department of the Army was the leading service branch to support OIF and OEF campaigns between 2005 and 2016. Nearly 70% of the three million service members who supported both deployments were Army soldiers, and they primarily served in combat operations. After returning from conflict, approximately 300,000 soldiers visited the VA for the first time. One-third of the population was diagnosed with severe neuropsychopathologies related to psychosocial and behavioral issues due to OIF and OEF campaigns (VHA, 2015). PTSD and depression were the leading severe neuropsychopathologies identified among combat veterans (VHA, 2015).

Research showed that white male Army soldiers accounted for most non-routine and dishonorable discharges due to misconduct, administrative actions, violent crimes, and other serious offenses. Additionally, most of the population were enlisted in their late 20s, single, and only had a high school education (VHA, 2015). Finally, white male Army soldiers were the leading population in violent crimes. In addition, they were diagnosed with mTBI and PTSD, and depression comorbidities compared to other racial and ethnic backgrounds (VHA, 2015).

PTSD was identified as the leading severe neuropsychopathological diagnosis of combat veterans returning from OIF and OEF campaigns. It was the primary mental health condition of those who received dishonorable and non-routine discharges (Smith, 2020; Brignone *et al.*, 2017). Additionally, combat veterans with PTSD diagnoses are at a higher risk for committing violent crimes with increased mortality rates (Giesinger *et al.*, 2020; Hamwey *et al.*, 2020). The mental disorder was reported as the primary concern in how to combat deployments impact mental health conditions (Sullen *et al.*, 2021; Tate *et al.*, 2021; Rull, 2020; Dieter & Engel, 2019).

PTSD and mTBI comorbidities are linked to significant neurocognitive decline. For example, evidence showed that combat veterans with both brain injury and psychiatric conditions had verbal memory dysfunction, reduced attention capacity, higher stress levels, poor sleep quality, emotional distress, and harmful effects on cognitive processing speed and visual attention measures (Sullen *et al.*, 2021; Tate *et al.*, 2021; Dieter & Engel, 2019; Mattson *et al.*, 2019; McInnes *et al.*, 2017; Combs *et al.*, 2015). Such conditions caused concern for personnel readiness standards and deliberated whether service members were "combat ready" for military operations.

Research question four

How can policymakers, defense leadership, and military legal professionals work with mental health experts to develop neuropsychopathological initiatives?

Since the aftermath of the historical wars of the 20th century, mental health initiatives have been established to provide treatment for combat veterans. For example, Congress established Psychological Health and Traumatic Brain Injury Research to assist the rise of severe neuropsychopathologies, particularly mTBIs, PTSD, and depression (U.S. Department of Defense, 2021). Also, the Congressionally Directed Medical Research Program was established to advance medical and psychological research on brain injuries, establishing neuropsychological initiatives.

The White House collaborated with DARPA to establish the BRAIN initiative to advance neuropsychological programs through neurotechnology research. In the early 1990s, the DoD created DVHIP to modernize research initiatives and educational programs to assist service members and veterans diagnosed with brain injuries. Now known as DVBIC, the organization is charged with improving neuropsychological screenings to prevent or reduce brain effects due to injuries.

Initiatives have been established to understand the complexity and treat service members' mental health conditions and brain injuries; however, there are insufficient resources and programs to examine the relationship between severe psychopathologies and brain functioning (i.e., neuropsychopathology). Additionally, there is limited research to determine the gravity of severe neuropsychology pathological conditions and comorbidities and how to treat those conditions.

Implications for professional practice

This study utilized the systematic literature review approach based on the PRISMA model to examine how severe neuropsychopathologies alter brain cortical structures in combat veterans due to combat exposure and trauma. The study also explored how combat veterans diagnosed with severe neuropsychopathologies predisposed them to commit violent crimes and how this impacts personnel readiness to complete military service obligations. PTSD, mTBI, and depression comorbidity were the leading severe neuropsychopathologies to impact combat veterans who served in OIF and OEF campaigns. Additionally, they were at higher risk of committing violent crimes than others not exposed to combat and trauma.

To support forensic neuropsychopathology, the amalgamation of clinical neuropsychology and forensic literary works was examined to show emerging research on how mental diseases affect the brain and their association with the military legal system. In addition, further exploration of forensic neuropsychopathology examined how service members exposed to combat and trauma are predisposed to committing violent crimes. Evidence revealed how this influences military and personnel readiness standards and what it means within the military justice system. Finally, the psychological resilience theory was incorporated as an integrated theoretical framework that supports how the military culture is conducive to service member's ability to conduct military operations through adverse climates.

Although Congress, the White House, and DoD have established initiatives to improve neuropsychological conditions within the military, there is a necessity for advanced neuropsychological initiatives to understand how mental diseases impact brain functioning. Since prolonged effects of severe neuropsychopathologies have impacted brain functioning, it reduces service members' chances of maintaining their personnel readiness standards. As a result, instability in personnel readiness standards affects force structure mandates to complete military operations.

The U.S. Department of the Army was the leading service branch of OIF and OEF campaigns and had the most service members to serve in combat deployments. Therefore, the Army developed a specific software program to monitor behavioral conditions and ensure combat readiness standards with many personnel challenges. The Commanders' Risk Reduction Toolkit (CRRT) is to help "command and battalion commanders better understand their soldiers, which could help mitigate potential risky behaviors or other issues that could hurt their combat readiness" (Lacdan, 2020, para. 2). Though CRRT is a web-based system that focuses on the U.S. Army's soldier risk factors, obtaining aggregate data was an integral component for this research study.

According to the National Academies Press (2010), over 1.9 million U.S. Army soldiers served in OIF and OEF, the largest populations of all service branches to serve in combat deployments. Also, most U.S. Army populations served in combat operations during both campaigns (National Academies Press, 2010). Therefore, the final data analysis process would be obtaining data from government archival records. Archives are critical to establishing a baseline of data and comparing it to current findings.

The CRRT gathers demographic information and characteristics (i.e., rank, years of service, deployments, mental health diagnoses data, etc.) to identify trends and patterns and provide statistical analysis for Army leadership when dealing with personnel readiness and force structure requirements. It is a catalyst for examining themes and patterns through analyzed data to identify risk themes among soldiers diagnosed with mental health illness, misconduct, medical conditions, and behavior histories (U.S. Department of Army, n.d.; Lacdan, 2020). The database can provide historical and current information that would be critical in understanding service members' readiness and force structure correlates to improving severe neuropsychopathologies. This is an imperative strategy in forensic neuropsychopathology.

CRRT is a baseline model for other service branches to establish similar programs to obtain analytical and statistical data. Combat deployments are not the only events that develop or impact psychiatric conditions (i.e., training accidents, motor/vehicular accidents, death, etc.). Hence, it is essential to have such information to monitor all service branches' behavioral and administrative actions. In addition, programs like CRRT can provide needed data on service members prone to psychiatric or worsened psychological conditions. Thus, this would be the initial step in identifying service members as potential participants for neuropsychopathological research.

Recommendations for research

This systematic literature review is conceptually established and should be continued for further research. A mixed-methods study should be conducted based on the findings indicative of Norman Garmezy's resilience theory and the emerging conceptual framework for forensic neuropsychopathology. These theoretical models denote innovative concepts to expand forensic neuropsychopathology and apply it to military healthcare and justice systems. Future research would examine severe neuropsychopathologies (i.e., MDD, mTBI, and PTSD) and affected brain regions through neuroimaging (i.e., fMRI). Additionally, such research would explore the relationship between severe neuropsychopathologies (i.e., MDD, mTBI, depression) and a predisposition to commit violent crimes (i.e., severe military offenses, killings, robberies, domestic violence). Further, additional research would explore how combat veterans these issues directly impact national security.

Utilizing a cohort study would further examine the outcomes and effects with variations in psychiatric conditions and environmental influences as they impact neuropsychopathological progression, social change, emotional regulation, and behavioral effects. Future research should investigate a causal relationship between prolonged combat exposure and trauma leading to severe neuropsychopathologies that alter specific brain regions, influencing fundamental cognitive processes and altering emotions, behavior, logic, and reasoning. Such research should assess how these variables predispose combat veterans to commit violent crimes. The holistic neuropsychopathological development process should also be examined, returning from a combat deployment to various psychiatric evaluation phases. Incorporating frameworks utilize psychological and resilience theories that are valid and reliable to improve advanced neuropsychopathological initiatives.

This study does not indicate whether combat veterans diagnosed with severe neuropsychopathologies can remain on active duty. Additionally, there is a lack of statistical evidence on the number of violent crimes committed over a specific period and the consequences of their actions on active duty (i.e., incarceration, house arrest, psychiatric hospitalization). Finally, additional research must explore more specific clinical initiatives focusing on forensic neuropsychopathologies and how they impact the military justice system. Healthcare professionals, scientists, policymakers, and educators can work together to improve policies and guidelines that can consider advanced neuropsychopathological initiatives to enhance mental health programs and treatment for military service members. The conceptual framework, forensic neuropsychopathology, was introduced to describe how different cortical brain structures and severe neuropsychopathologies impact service members' behavior.

Conclusion

This study examined combat veterans diagnosed with severe neuropsychopathologies due to combat exposure and trauma from serving in OIF and OEF campaigns. Further, whether combat veterans were predisposed to commit violent crimes was explored to determine whether they could remain on active duty. PTSD, mTBI, and depression comorbidity were the leading severe neuropsychopathologies to impact combat veterans who supported military operations in OIF and OEF. Additionally, they were at higher risk of committing violent crimes than others not exposed to combat and trauma.

Research suggested that younger, white enlisted males in the Army had a higher rate of committing violent crimes. However, there was limited data to determine if they could remain on active duty. Additionally, insufficient research proves whether combat veterans are criminally responsible for committing violent crimes. DoD policies mandate that service members be physically, psychologically, and medically fit to complete military service obligations. According to PEB and MEB standards, combat veterans with severe neuropsychopathologies do not meet the criteria to remain on active duty; however, there is insufficient data to determine if severe mental health conditions are the sole purpose for medical and non-routine discharges due to not meeting personnel readiness standards. Therefore, to understand the complexity of the dilemma, additional research is needed to support the importance of forensic neuropsychopathology.

Pertinent neuropsychological assessments and functional medical tools were acknowledged to give an in-depth analysis of studying brain activity and examining for possible brain injury or impairment. In addition, the theoretical development of psychopathology was explained under how severe mental illness impacts brain functioning. Finally, neuroplasticity was discussed to provide critical analyses of the brain's ability to change through reorganizing neural pathways throughout an individual's life and how this concept is vital for advanced neuropsychopathological initiatives within DoD.

The conceptual framework, forensic neuropsychopathology, was introduced to describe how different cortical brain structures and severe neuropsychopathologies impact service members' behavior. To support forensic neuropsychopathology, the amalgamation of clinical neuropsychology and forensic literary works was examined to show emerging research on how mental diseases impact the brain and how these discoveries impact civilian and military justice systems.

Further exploration of forensic neuropsychopathology examined how service members exposed to combat and trauma are predisposed to committing violent crimes. This was essential in assessing military and personnel readiness standards within the military justice system. Finally, the psychological resilience theory was incorporated as an integrated theoretical framework that supports how the military culture is conducive to service member's ability to conduct military operations through adverse climates.

Data availability

Underlying data

Harvard Dataverse: Replication Data for: Forensic neuropsychopathological analysis on altered brain structures in combat veterans: A systematic review, https://doi.org/10.7910/DVN/A306BT.

This project contains the following underlying data:

- Appendices (Forensic Neuropsychopathology).docx

Reporting guidelines

Harvard Dataverse: PRISMA checklist for forensic neuropsychopathology, https://doi.org/10.7910/DVN/XI7HRC.

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