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Differences in Research on Post-Traumatic Stress Disorder: How Trauma-Type and Sex Contribute to the Published Research

By Jessica Anzalone¹, Sharon Ramos-Goyette², Marissa Morganelli³, Merideth Krevosky⁴

Abstract

There is a pervasive and comprehensive history of sexism in the pursuit of scientific truth, extending back beyond the days of “hysteria” and continuing still. Herein, we discuss a disparity in scientific research on a disorder thought to affect less than 8% of the adult population in the USA with the number of women diagnosed with the disorder estimated to be two to three times higher than that of men. While post-traumatic stress disorder (PTSD) is more likely to be experienced by women, we find that the overwhelming majority of published scientific literature on PTSD involves male combat veterans. For example, since March 2019, according to a widely used medical research search engine, specifically the electronic database PubMed (<https://www.ncbi.nlm.nih.gov/pubmed/>), over 1,100 articles can be found with the keywords, “veteran and PTSD” while using the keywords, “sexual assault and PTSD” yields a little over 100 total articles. While not all victims of sexual assault are female and not all combat veterans are male, the majority sex in each category is such that much of the research on “veteran” was specifically carried out with male veterans and much of the work on “sexual abuse” was carried out exclusively with females. This creates a perception that both overinflates the incidence of PTSD experienced by male combat veterans and underemphasizes the experience of PTSD in female victims of sexual assault. Differences in symptoms of PTSD do vary by war and what little research exists on PTSD after sexual assault suggests that it is likely that symptoms as well as associated comorbidities will vary depending on the cause, type, number, and age at first trauma, among other factors. This study focuses on the specific comorbidities of pain, addiction, and immune function in those who experience PTSD following war-based or sexually-based traumas. It is our hope that in reviewing the currently available research, we spotlight the need for research

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focused on PTSD experienced after sexual assault. Doing so has the potential to lead to better and more tailored treatments for PTSD, thus enriching outcomes for all sufferers of PTSD.

Keywords: Sex-differences, PTSD, Bias in research

Introduction

Culture, politics, the legal and judicial systems as well as institutionalized “truths” suffuse our fundamental understanding of biology in a way that usually promotes the status quo to foster and perpetuate pre-established hierarchies. Among other things, this impacts how questions of scientific inquiry are formulated and of which populations those questions are asked—ultimately biasing the “knowledge” that is obtained. For example, the research presented here began as an inquiry into whether trauma-type causes different symptoms in those who experience Post-Traumatic Stress Disorder (PTSD). Indeed, there are differences in PTSD between veterans of different wars (Golier, Caramanica, & Yehuda, 2012) and we hypothesized there would be differences in PTSD between victims of sexual assault compared to military combat veterans. However, when we began the research, we were unable to address this question due to the paucity of data on PTSD as a result of sexual assault. The mismatch between the numbers and the research suggests a cultural bias that validates and contributes to the socio-cultural norm which almost expects PTSD to result from combat, but not from sexual assault. This creates issues for both those returning from combat and victims of sexual assault because it reinforces the original cultural perception and changes the phenomenological experience of the individual depending on where that individual fits within the cultural-socio context.

While other factors may contribute, the disparity in research is almost certainly related to the intersectionality of the current and historical status of “women” as a group as well as socio-cultural perceptions of sexual assault. Sex differences in the incidence of PTSD have been ascribed to biological/genetic risk factors (Yehuda et al., 2015), but it is more likely that PTSD is experience-specific. For example, a study of Native Americans showed a particularly high incidence rate of 12% PTSD and found that trauma type, specifically sexual trauma, significantly contributed to a higher incidence of PTSD diagnosis (Gnanadesikan, Novins, Beals, & American Indian Service Utilization, Psychiatric Epidemiology, Risk and Protective Factors Project (AI-SUPERPPF)/Healthy Ways Research Teams, 2005). While only one traumatic event may elicit PTSD, it is also the case that the number of traumas can impact the likelihood of PTSD. This study found that the average total number of traumas contributing to the development of PTSD is higher (requiring six or more traumas) for marginalized groups compared to those in the general population, which is typically four events (Yehuda et al., 2015). While it has been proposed (Yehuda et al., 2015) that there is an inherent risk for developing PTSD in marginalized groups, particularly women, the data described above, in fact, argue the opposite.

Data from those with PTSD who served on the ground in the Vietnam War also support the opposite of a biological predisposition for women to develop PTSD. Forty years after the Vietnam War, there is a sex difference in PTSD rates, but in the opposite of the predicted direction: 7% of females while 11% of males continue to experience PTSD (“PTSD and Vietnam Veterans: A Lasting Issue 40 Years Later - Public Health,” n.d.). Thus, women may not be more likely to experience PTSD but instead are more likely to experience the types of violent and interpersonal traumas that are most likely to precipitate PTSD.

While it may be obvious that sexual assault is a traumatic experience at the individual level, there is a disconnect at the socio-cultural level. Despite some progress (Bower, 2019; Szkeres et

al., 2020) since #MeToo,⁵ there is a normative devaluing of the experience of sexual assault. This becomes clear when we compare sexual assault to other crimes. According to the Rape, Abuse, Incest, National Network (RAINN), in the United States, of every 1,000 instances of rape, only 230 are reported to the police leading to about 7 convictions; whereas for other felonies, such as robberies or assault and battery, the rate of reporting is about three times higher, and the higher conviction rates are four and eight times higher, respectively (“Victims of Sexual Violence: Statistics | RAINN,” n.d.). To this point, the American Psychiatric Association itself categorizes sexual assault as trauma similar to a car accident or weather event (American Psychiatric Association, 2013). This socio-cultural perspective that minimizes the experience of sexual assault has likely contributed to its lack of inquiry as an important, unique contributor to PTSD.

A second important contributing factor to the disparity is simply that there is less scientific research on females than males overall. It is estimated that 82-90% of sexual abuse victims are female (“Victims of Sexual Violence: Statistics | RAINN,” n.d.).⁶ As recently as 2014, the Director of the National Institutes of Health along with the Director of the US National Institutes of Health Office of Research on Women’s Health, and Associate Director for Research on Women’s Health, announced a policy change in funding that would require NIH-funded researchers to provide a plan for inclusion of female representation in preclinical work (e.g. animal research models) (Clayton & Collins, 2014). Even in 2014, the requirement to provide parity in research was met with controversy (Fields, 2014). While bias in the socio-cultural perspective of sexual assault and the status of women have contributed to the lack of research on PTSD after sexual assault, it is clear that inclusion of female subjects in studies on PTSD is necessary to advance a greater and more detailed understanding of this condition.

PTSD—Clinical Definition

What is currently known of PTSD begins with established diagnostic criteria. There are two diagnostic tools commonly used to assess PTSD; these are the Diagnostic and Statistical Manual of Mental Disorders produced by the American Psychiatric Association, now in its 5th edition, and referred to as the DSM-5 (American Psychiatric Association, 2013) and the International Classification of Disease or ICD produced by the World Health Organization and now in its 11th version (ICD-11). The diagnostic criteria for PTSD differs between these two clinical resources, but broadly defined, PTSD is a trauma and stress-related disorder that may develop from a single specific brief traumatic event or in situations involving long term patterns of regular abuse, trauma, and/or chronic victimization.

Lifetime prevalence of PTSD in the United States is about 8%. On a global scale, this ranks the United States particularly high when compared to countries in South America, Europe, Africa, and Asia whose prevalence rates fall between 0.5-1% (American Psychiatric Association, 2013) and one reason for this may be that the ICD-11 has a much narrower definition of PTSD than the DSM-5 (Kuester et al., 2017).

Here, we briefly outline the DSM-5 criteria since this is what has typically been used in the research. Following trauma exposure, individuals who develop PTSD experience one or more intrusive symptoms, such as recurring memories or dreams relating to the traumatic event, dissociative reactions, or “flashbacks.” This presents with psychological distress and/or

⁵ The phrase “MeToo” was coined in 2006 by Tarana Burke and gained traction as a social movement in 2017 when Alyssa Milano posted #MeToo and encouraged others who have experienced sexual assault to speak out.

⁶ For additional information on the intersectionality of sexual assault in children (boys and girls), those in the LGBTQ+ community, by race, or in prison or military populations, please see RAINN.org.

physiological changes in response to thoughts and/or external cues reminiscent of the trauma including places, events, or environmental stimuli—commonly referred to as “triggers.” Changes in mood and cognition are also present and at least two indicators of such are required for diagnosis. In addition, individuals with PTSD may experience hyper-arousal that manifests for example with self-endangerment, hypervigilance, or an increased startle response (American Psychiatric Association, 2013). Alternatively, individuals may present with hypo-arousal, which includes emotional detachment and is classified as a dissociative subtype of PTSD, or PTSD-DS. Altogether, symptoms must last more than a month and create functional impairments in everyday life.

Moreover, individuals with PTSD have an 80% greater likelihood to meet criteria for at least one additional disorder than individuals who do not have PTSD (American Psychiatric Association, 2013) commonly referred to as “comorbidities” (Shipherd et al., 2007). Such comorbidities include but are not limited to chronic pain (Noel et al., 2016), substance abuse (McCauley et al., 2012), and functional alterations in the neuroendocrine axis as well as immune function (Neigh & Ali, 2016) potentially leading to a higher risk for developing non-insulin dependent or type II diabetes (Blessing et al., 2017). Since the presentation of additional disorders and behaviors of those with PTSD are diverse, an appropriate diagnosis is often clinically difficult which may contribute to the underrepresentation of data on females with a diagnosis of PTSD.

Physiology of PTSD

From a biological perspective, PTSD has traditionally been viewed through the lens of an altered stress-response that develops in the aftermath of a single or repeated trauma(s). However, emergent research is showing that physiological parameters that had once been considered the result of PTSD may instead be physiological risk factors for the development of PTSD (Golier, Caramanica, & Yehuda, 2012; Yehuda et al., 2015).

The immediate physiological response to a stressor, commonly known as the “fight or flight” response, has been evolutionarily optimized to sequester resources to mitigate a threat and is characterized by acute indicators such as increased pulse and respiration rate. This response is carried out by the sympathetic nervous system mediated by the release of adrenaline (also called epinephrine).

The more prolonged response is neuroendocrine and involves the sequential release of hormones from several tissues. It is often referred to as the “HPA” because of the three organs involved (i.e. hypothalamus-anterior pituitary-adrenal) and the sequential hormone release from each organ. First, the hypothalamus releases corticotropin releasing hormone (CRH), which causes the anterior pituitary to secrete proopimelanocortin (POMC) which then leads to the secretion of both natural opioids and adrenocorticotrop hormone (ACTH), ultimately eliciting cortisol release (summarized in Sapolsky, 1994). Among other functions, opioids play an important role in pain perception and cortisol plays an important role in immune function and inflammation which both contribute to the chronic pain, addiction and changes in immune function that often present in those with PTSD.

Brain Areas Involved in PTSD: Hippocampus, Amygdala, and Prefrontal Cortex

In addition to changes associated with the neuroendocrine axis, changes in function of several brain areas have been implicated in those with PTSD. These brain areas include: the hippocampus, the amygdala, and the prefrontal cortex (Yehuda et al., 2015). The hippocampus plays an important role in the conditioning of stress responses, declarative memory, and fear

extinction and is an important target for cortisol (Popoli, Yan, McEwen, & Sanacora, 2011) making it of critical importance in the study of PTSD (Bremner et al., 1997; Gilbertson et al., 2002; van Rooij et al., 2015). For example, the effects of cortisol in the hippocampus are likely responsible for “flash-bulb” memories connected to significant stressful experiences and explains why individuals can recall seemingly non-essential details (e.g. the weather) that surrounded a particular significant event. In PTSD, these “details” may become “triggers.”

Another key brain area in PTSD is the amygdala which shares reciprocal connections with the hippocampus. The integration of stressful stimuli, emotional processing, and fear is coordinated by the amygdala. Individuals with PTSD can display both hypo-activity and hyper-activity within the amygdala (Nicholson et al., 2017) and increased amygdala volume is found in animal studies of PTSD (Harmon, Greenwald, McFarland, Beckwith, & Cromwell, 2009; Uno, Tarara, Else, Suleman, & Sapolsky, 1989). Given its role in fear and emotion, it is not surprising that alterations in the amygdala may occur in those with PTSD.

A third brain area of importance is the prefrontal cortex (PFC). This is the area of the brain that takes the longest to develop. In humans, it is not considered fully developed until around 25 years of age. Evolutionarily, it is also the “newest” part of the brain. In otherwise healthy individuals, the PFC plays an important role in impulse control and in inhibiting inappropriate behaviors and is the brain region targeted in the treatment of attention-deficit hyperactivity disorder. It is thought that the prefrontal cortex modulates behavior in part because of its role in working memory and for those experiencing PTSD, the PFC is of vital importance in promoting fear extinction and reducing acquired fear responses. Both of these are accomplished through the PFC’s connections with the hippocampus, amygdala, and periaqueductal gray matter. PFC volume tends to be decreased in children who experience emotional abuse or neglect (van Harmelen et al., 2010) and altered PFC activation contributes to the expression of PTSD subtypes (Nicholson et al., 2017).

Given the changes in physiological function associated with PTSD, we set out to explore the differences between two populations diagnosed with PTSD: combat war veterans and survivors of sexual abuse or assault. We focused on three conditions common in those with PTSD: chronic pain, addiction, and changes in immune function and hoped to use what we learn to provide a better understanding of PTSD elicited in different contexts. Herein, we reveal instead that the primary scientific literature on PTSD is sex-biased. In the Discussion, we suggest that this disparity has contributed both to cultural inaccuracies in the perception of the dynamic and interacting factors that contribute to the disease and has also dramatically limited the scientific questions asked about the disease itself.

Methods

Against this background of physiology, we attempted to discern symptomology in PTSD depending on trauma type. Instead, we were faced with a discrepancy in population-based PTSD research that we present here.

To access research, we used the premier biomedical search engine, PubMed. According to its website (www.pubmed.gov), it “comprises more than 30 million citations for biomedical literature from MEDLINE, life science journals, and online books.” Much of the most cited, peer-reviewed biomedical research is accessed through this valuable website. Thus, this is an appropriate search engine to assess research publication numbers screened by title keywords.

Results

Sex-Differences in Total Numbers of Publications

Our first surprising finding involved overall publication numbers (Figure 1). The total number of articles published and cited are reported for prior to March 2019 and then limited to a more recent research, where the search was limited to the years 2014 through March 2019. All terms were required in each search to generate the data. The data show that in reviewing all articles prior to March 2019, there are a total of 1,150 articles that focus on PTSD and veterans while only 124 focus on PTSD and sexual assault. More specifically, the data show that there are strikingly more articles that use the keywords *PTSD* and either *veteran* (n=847) or *combat* (n=303) as compared to the number of total publications that use *PTSD* along with *sexual abuse* (n=49), *sexual assault* (n=42), or *rape* (n=33). Furthermore, in focusing on a smaller and more recent time frame of January 2014 through March 2019, there are a total of 559 articles that focus on veterans and use the keywords *PTSD* and either *veteran* (n=450) or *combat* (n=104), as compared to only 50 total publications that use *PTSD* along with *sexual abuse* (n=18), *sexual assault* (n=19), or *rape* (n=13). More research is necessary to discern the underlying cause of this differential in publication number in the populations addressed here.

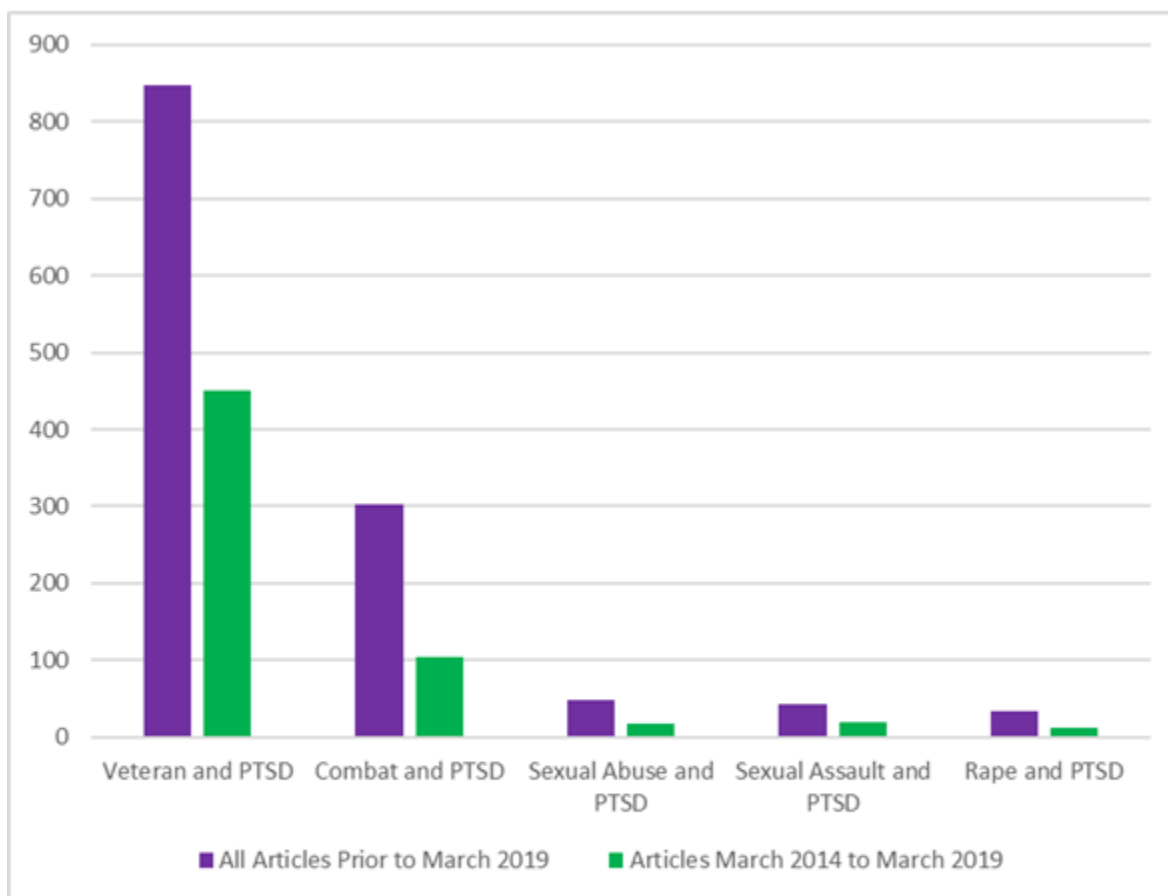


Figure 1. Number of Manuscript Titles with PTSD and Specific Title Keywords as identified using PubMed. Total number of articles published and cited in PubMed with titles using relevant keywords through March 2019 and then limited to January 2014 through March 2019. Searches were run requiring the presence of both *PTSD* and each relevant key word in the publication title.

Comorbidities

Chronic Pain

This study subsequently focused on three conditions often found to be comorbid with PTSD: specifically, chronic pain, addiction, and changes in immune function. Chronic pain, which is defined as any form of pain lasting for more than twelve weeks, is often comorbid with PTSD. Our study again found that most of the PTSD research on pain has been conducted with combat veterans (Figure 2). The dysregulation of the HPA axis resulting from PTSD provides one explanation for the high comorbidity with chronic pain. It is hypothesized that cortisol, an anti-inflammatory and the hormone mimicked with cortisone shots, as well as endocannabinoids and opioids play a role in pain management and all are implicated in PTSD. It had previously been predicted that individuals with PTSD have higher cortisol levels but, in fact, in comparison to “normal,” those suffering from PTSD have lower levels of cortisol (Golier et al., 2012; Szeszko, Lehrner, & Yehuda, 2018), therefore decreasing the body’s ability to reduce pain using its own chemical mechanisms by way of the HPA axis.

Chronic pain comorbid with PTSD has been reported in up to 50% of male combat veterans (Gros, Szafranski, Brady, & Back, 2015; Kerns, Otis, 2003). Figure 2 shows that much research has examined the relationship between PTSD and chronic pain in male combat veterans and this may lead to a greater understanding of forms of PTSD more frequently identified in male veterans.

On the other hand, what little we know about the comorbidity of chronic pain and PTSD in survivors of sexual assault suggests that the pain experienced by the two groups is vastly different. For example, women who experience chronic pain comorbid with PTSD that precipitated from sexual assault experience primarily pelvic pain, abdominal pain, chest pain, and genital pain (Meltzer-Brody et al., 2007; Yeh, Watanabe, Sulkes-Cuevas, & Johansen, 2018); whereas, women veterans whose PTSD precipitated from combat primarily experience pain as arthritis and chronic lower back pain (Price, McBride, Hyerle, & Kivlahan, 2007). The limited research in women with PTSD, either in female veterans or female sexual assault survivors, suggests an urgent need for more research to, at the very least, promote awareness of differences in chronic pain depending on trauma type. Since 2014, there are a total of 183 articles that focus on veterans and use the keywords *pain* and either *veteran* (n=164) or *combat* (n=19), as compared to only 6 total publications that use *pain* along with *sexual abuse* (n=5), *sexual assault* (n=1), or *rape* (n=0). This disparity likely reflects an underrepresentation of chronic pain in females who experience PTSD, and sheds light on the need for a better understanding of these comorbidities.

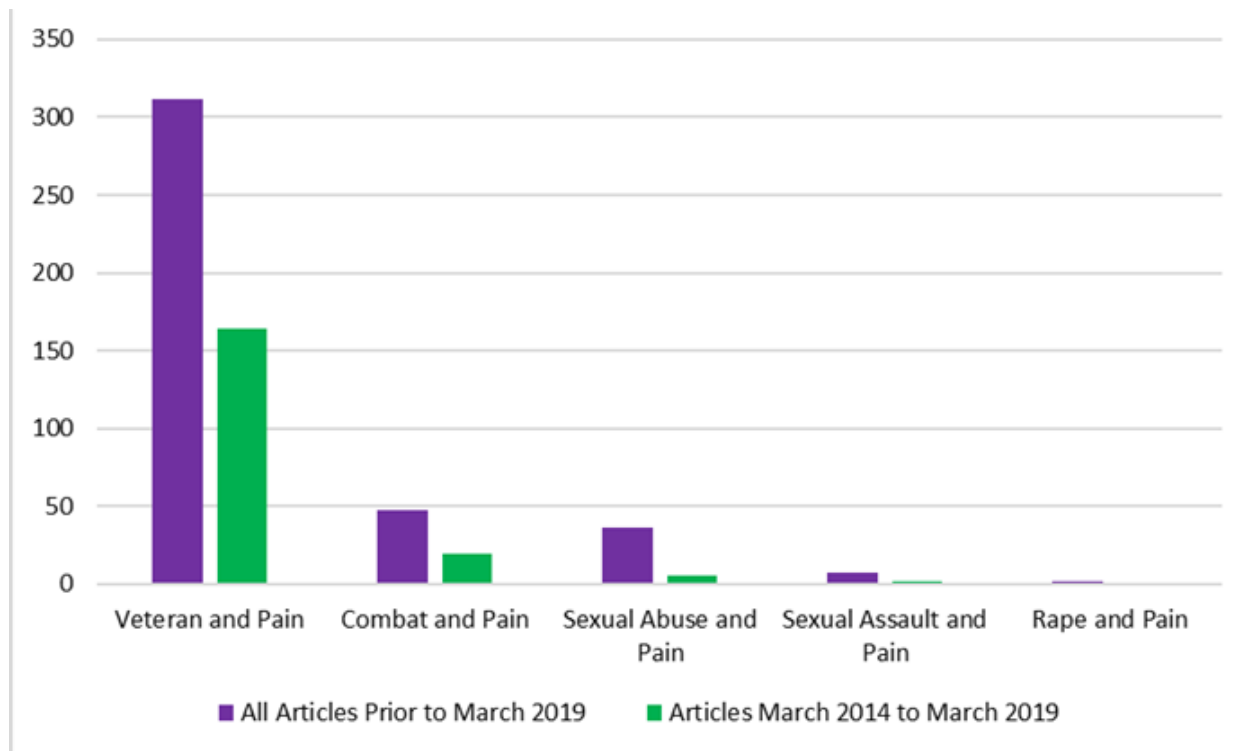


Figure 2. Number of Manuscript Titles with Pain and Specific Title Keywords as identified using PubMed. Total number of articles published and cited in PubMed with titles using relevant keywords through March 2019 and then limited to January 2014 through March 2019. Searches were run requiring the presence of both *Pain* and each relevant key word in the publication title.

Addiction

Individuals with PTSD frequently present with addiction which is linked to disrupted dopamine function since substances which are abused (most often, opiates, alcohol, and marijuana) target this reward-based neurotransmitter (Blum et al., 2019; Hill et al., 2013; Rasmussen et al., 2019, 2017, 2006; Wood et al., 2007). Opiate abuse in particular has increased amongst veterans, as they are often prescribed to treat chronic pain, further deepening the connection between chronic pain and addiction in this population (Bernardy & Montaña, 2019). Additionally, impairment of the prefrontal cortex associated with PTSD could put individuals with the diagnosis at higher risk for engaging in substance abuse due to their resulting difficulty with impulse control (American Psychological Association, 2013). Furthermore, the prevalence of chronic pain in those with PTSD combined with disrupted healthy opioid and neurosteroid function further exacerbates the likelihood of drug use as self-medication (Bernardy & Montaña, 2019). This dysfunctional neurobiology combined with a need to escape the reality of the trauma creates a neurobiological context ripe for substance abuse. One study (Najavits & Walsh, 2012) estimates that substance abuse among sexual assault survivors is between 30-59%. On the other hand, in a study of Vietnam veterans with PTSD, 70% were also found to be comorbid for alcohol use (Carter, Capone, & Eaton Short, 2011).

However, substance abuse (e.g. drug or chemical addiction) is not the only form of addiction in either veterans or victims of sexual assault. Victims of sexual assault, particularly those assaulted as children, (Howard, 2007) which is when the greatest number of assaults occurs (RAINN 2020) may also develop sexual compulsions. This occurs because victims may engage in

behaviors that precipitated a trauma to gain understanding and control over a situation where they previously had none. On the other hand, sexual compulsions are rarely reported in combat war veterans with PTSD. This underscores the need to consider the ways in which PTSD is experienced based on trauma type.

While addiction is often comorbid with PTSD, the data gathered here support that more publications focus on veterans rather than on survivors of sexual assault, leading to the conclusion that most of the research on addiction has been conducted with combat veterans (Figure 3). Indeed, since 2014, there are a total of 31 articles that focus on veterans and use the keywords *addiction* and either *veteran* (n=12) or *combat* (n=19), as compared to only 3 total publications that use *addiction* along with *sexual abuse* (n=3), *sexual assault* (n=0), or *rape* (n=0).

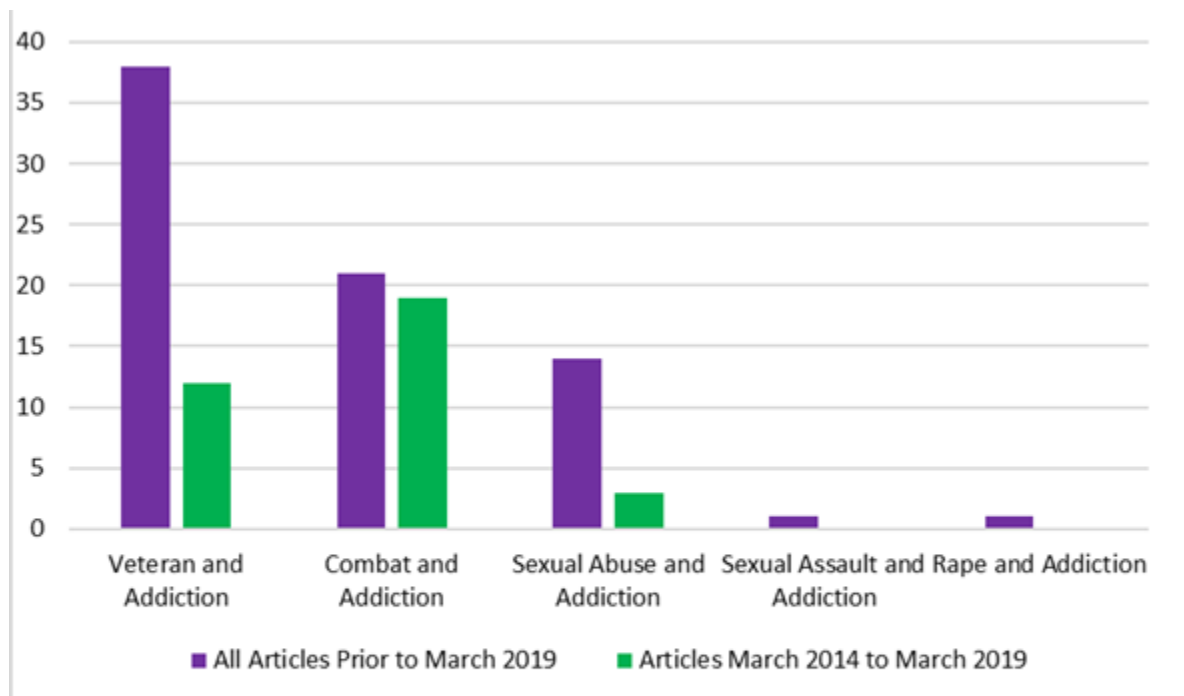


Figure 3. Number of Manuscripts with both Addiction and Specific Title Keywords as identified using PubMed. Total number of articles published and cited in PubMed with titles using relevant keywords through March 2019 and then limited to January 2014 through March 2019. Searches were run requiring the presence of both *addiction* and each relevant key word in the publication title.

Immune Function, Autoimmune Disease and Inflammation

Many aspects of the HPA impact immune function and the impact is nuanced such that some aspects of immune function are enhanced while others are diminished. Autoimmune diseases including Type I Diabetes, multiple sclerosis, and arthritis occur when the immune system targets otherwise healthy tissue. When veterans from the Iraq or Afghanistan wars with PTSD were compared to the general population, researchers found a two-fold increase in autoimmune disease and a 51% increase as compared to those without a psychiatric diagnosis (O'Donovan et al., 2015). However, for the population of male and female combat veterans who also experienced sexual trauma in the military (often referred to as Military Sexual Trauma or MST) and were diagnosed with PTSD, researchers found an increased risk for comorbid diagnosis with an autoimmune disease. The relationship between PTSD and immune dysfunction becomes even more multi-layered, though, because in general, women have a higher rate of all autoimmune disease, yet when women with PTSD are compared to men with PTSD, there is no overall difference in autoimmune disease (O'Donovan et al., 2015) suggesting not only an important sex difference in terms of clinical diagnosis, but also a very promising avenue of research to investigate the relationship between PTSD and autoimmune disease. As shown in Figure 4, since 2014, there are a total of 14 articles that focus on veterans and use the keywords *addiction* and either *veteran* (n=5) or *combat* (n=9), as compared to only 2 total publications that use *immune* along with *sexual abuse* (n=2), *sexual assault* (n=0), or *rape* (n=0). The disproportionate research where few articles overall relate immune dysfunction to PTSD indicates that this is a relatively new area of investigation. Indeed, a recent review reiterates the notion that linking immune disorders to specific types of PTSD is not yet understood and that reviews that focus on inflammation and PTSD show inconsistent findings, likely as a result of the heterogeneity of the disorder (Kim, Lee, & Yoon, 2020). This factor makes it difficult to disentangle immune function as related to PTSD resulting from various types of trauma. Taken together, a better understanding of disorders that involve stress and inflammation is warranted to better understand the mechanisms of how specific types of trauma underlying PTSD result in dysregulation of the immune system, particularly given the already known sex-differences in autoimmune disease.

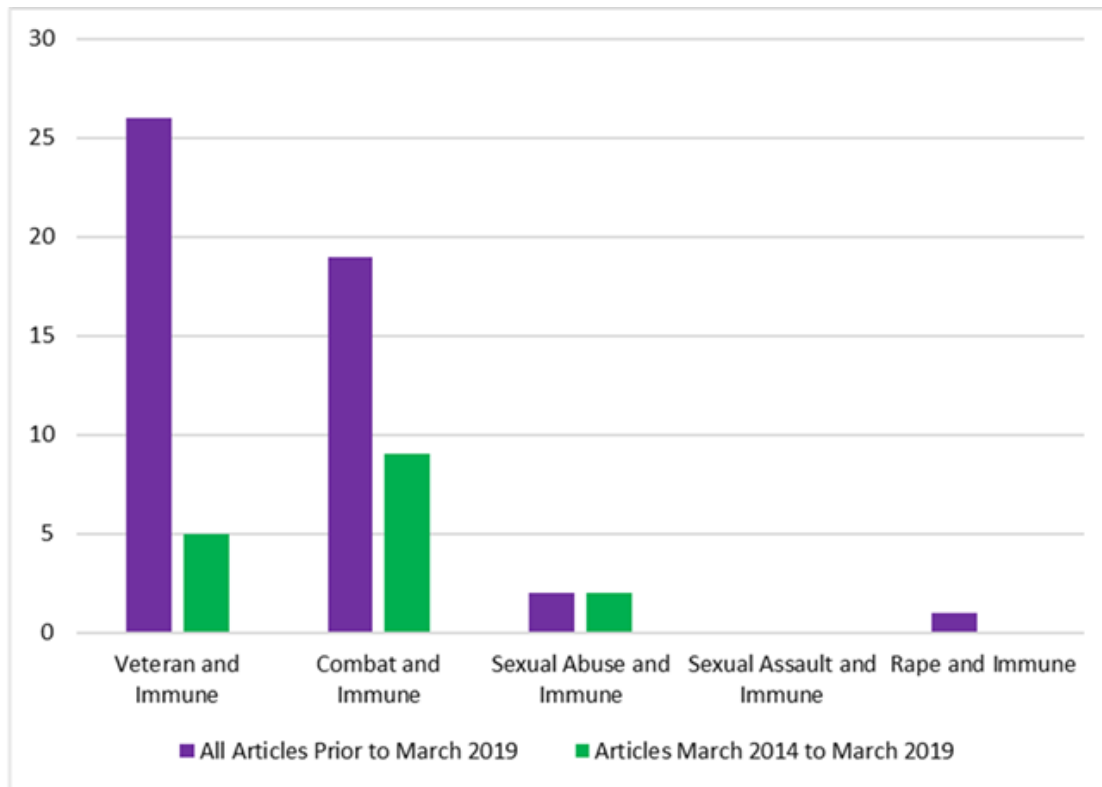


Figure 4. Number of Manuscripts with Immune and Specific Title Keywords as identified using PubMed. Total number of articles published and cited in PubMed with titles using relevant keywords through March 2019 and then limited to January 2014 through March 2019. Searches were run requiring the presence of both *immune* and each relevant key word in the publication title.

Life-time Prevalence of PTSD in the U.S. and Corresponding Research

An analysis of articles with titles containing keywords PTSD and some of the most common forms of precipitating trauma reveals that there are ten-times the number of publications on PTSD in combat veterans than there are for PTSD in sexual assault survivors. However, this is not representative of the populations who experience PTSD. When these publication numbers are compared to demographics representative of the relative frequency of precipitating trauma causes, the discrepancy is even greater. It is estimated that those experiencing PTSD as a result of combat experience represent 0.9% of cases of PTSD while 32.9% of cases can be attributed to sexual-relationship violence (Kessler & Üstün, 2004). Extrapolation of U.S. population data and lifetime prevalence of PTSD shows the extraordinary number of survivors of sexual assault or rape as compared to combat veterans (Figure 6). Thus, there is a significant imbalance between research and populations who experience PTSD. When the publication totals (Figure 5) are compared to the extrapolated lifetime prevalence totals of PTSD for specific forms of trauma, the greater focus on publication in the veteran population is undeniable (Figure. 7). The number of veterans per publication containing words PTSD and veteran in the U.S. as of March 2019, is approximately 240:1. Respectively, the number of individuals per publication for survivors of sexual assault is approximately 176,700:1 when related to publications containing sexual assault and PTSD. The discrepancy between specific demographics and PTSD publications could be either considered a failure to promote awareness for this disorder or a testament of the success of recent public awareness campaigns in advocacy of veterans. Regardless, our work demonstrates not only the

need to continue the research on PTSD in veterans, but also highlights the critical need to address the lack of research on PTSD as a result of sexual assault.

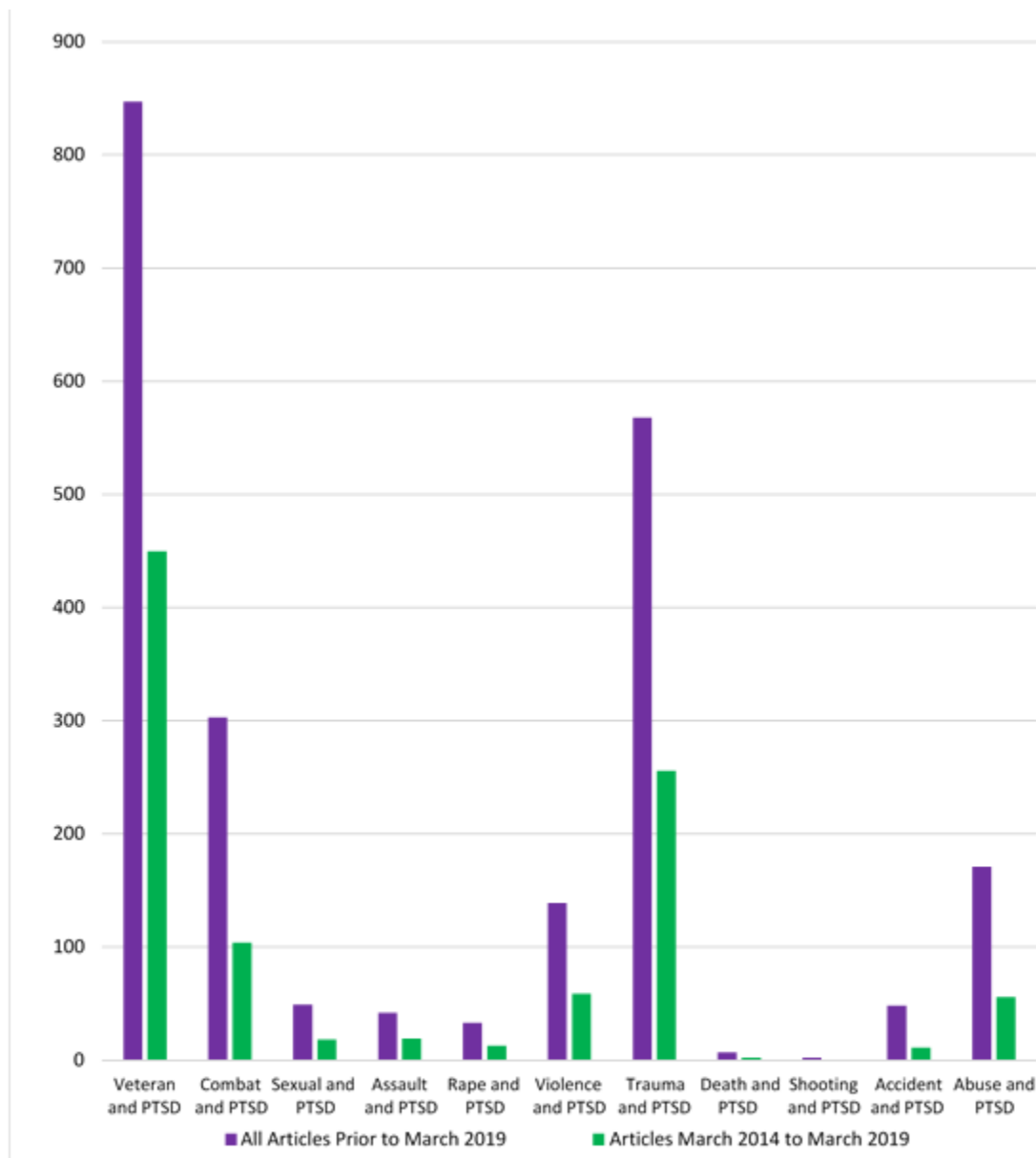


Figure 5. PubMed Document Totals for Trauma-Specific Title Keywords Graph comparing articles published and cited in PubMed with titles containing simplified relevant keywords in total through March 2019 and then limited to January 2014 through March 2019. All searches were run requiring the presence of both *PTSD* and the relevant keywords in the publication title.

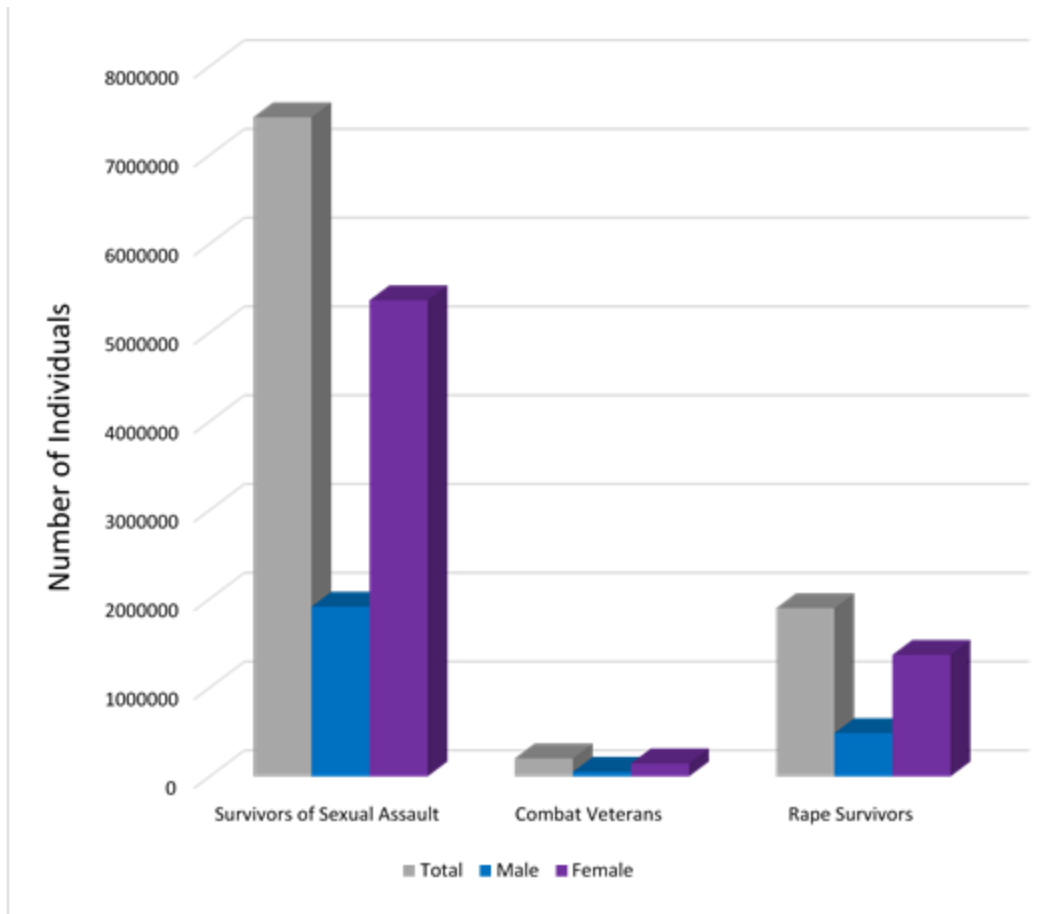


Figure 6. Extrapolated Lifetime Prevalence of PTSD Cases in the U.S. Lifetime prevalence totals of PTSD in U.S. citizens based on 2019 population demographics in each of three populations, survivors of sexual assault, combat veterans or rape survivors and distributions of conditional risk of PTSD (Kessler & Üstün, 2004). This data underscores that PTSD is reported in nearly 9,500,000 individuals who are survivors of sexual assault or rape as compared to 250,000 combat veterans who report PTSD.

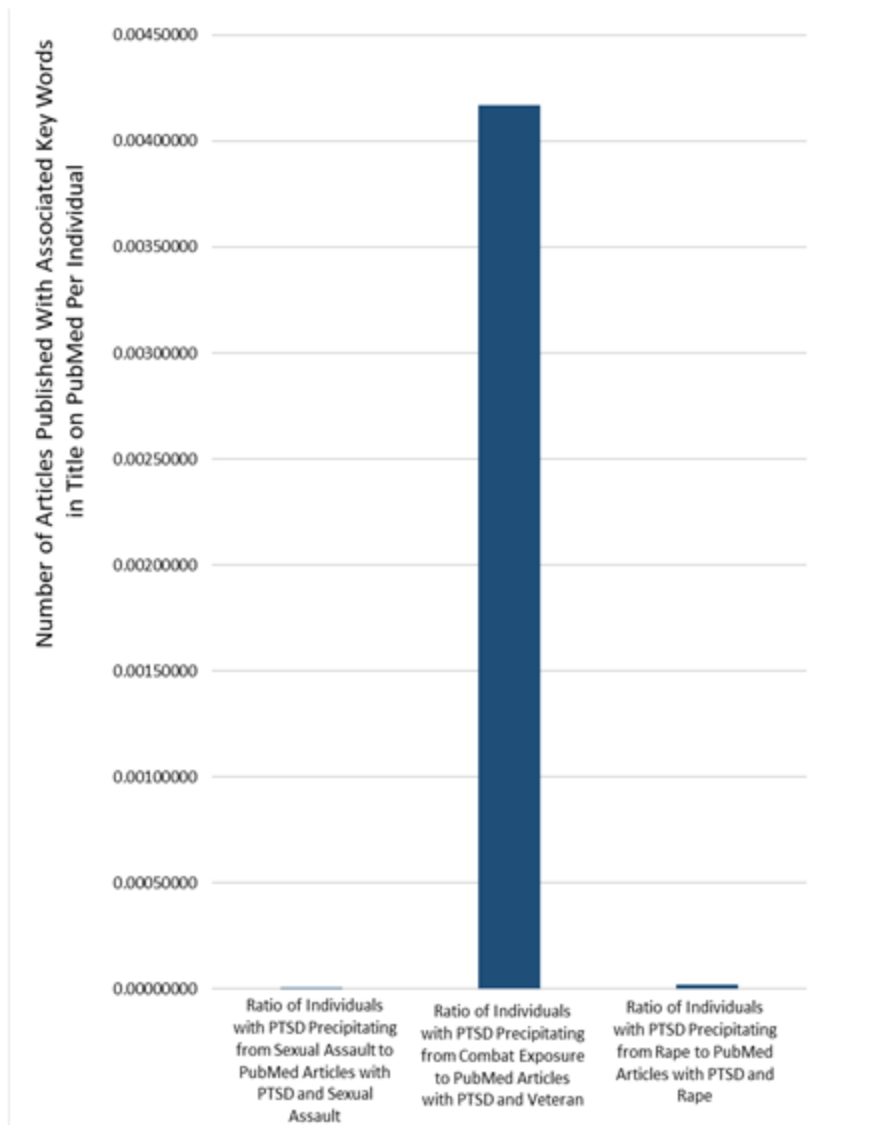


Figure 7. Ratio of PubMed Articles with Relevant Keywords to Individuals with PTSD Precipitated from Correlating Events Lifetime prevalence totals of PTSD as reported by U.S. citizens based on 2019 population demographics and distributions of conditional risk compared to total number of publications with title keywords on PubMed database from January 2014 through March 2019. These data underscore the striking lack of literature on PTSD as a result of sexual assault or rape as compared to combat veterans.

Discussion

It's Not Just PTSD

Because there is little data on women who experience PTSD as a result of sexual assault, researchers and clinicians must rely on what is known from the more abundant research of PTSD in combat war veterans, but the problem, as we have outlined here, is that these findings are not universally transferable. This sex disparity is true in other diseases as well, such as cardiovascular disease, and in both cases treatments that may work for men are not as effective in women (Stefanick, 2017). Research questions and the populations that most benefit from the research reflect societal priorities. Through the media or clinical recommendations, the research eventually makes its way into the collective social awareness. This then reinforces the original priority and promotes the status-quo. The disparity in research on cardiovascular disease is one reason that it has taken so long for society and clinicians to recognize and treat the potential for cardiovascular disease in women (Stefanick, 2017).

Even in the preclinical literature, there is a lopsided focus of research on males (McCarthy, Arnold, Ball, Blaustein, & de Vries, 2012). For example, it is estimated that preclinical research on male versus female animals is 5:1 (Beery & Zucker, 2011) and this is even higher in preclinical neuroscience research which is the umbrella under which PTSD research would fall.

The APA Definition of Trauma

While the APA identifies trauma as events ranging from a severe car accident to a weather disaster, it defies common sense to include sexual assault as a similar trauma type. The nature of sexual assault is personal and individual as it is an act committed by an individual(s) against another individual. A car accident or weather disaster are not individual events, rather these are events experienced by more than one individual at a given time. Neither are these events personal, instead they are caused by human error or atmospheric changes. These are not intentional acts. Acts of war are more similar to acts of sexual assault in that they involve the personal intentions of others, but here again, there is a difference in the shared experience of a military unit. As such, understanding the extent to which the targeted and personal nature of sexual assault leads to PTSD warrants further investigation.

Marginalized Groups and PTSD

It is often reported that women experience higher rates of PTSD than men even when accounting for sexual assault. However, for this statement to be meaningful, research needs to address the higher rate of PTSD among many marginalized groups. For example, Black Americans (Alegría et al., 2013; Roberts, Gilman, Breslau, Breslau, & Koenen, 2011) and Native Americans (Gnanadesikan et al., 2005) experience higher rates of PTSD than White Americans while Asian Americans experience the lowest prevalence of PTSD. Similarly, women experience higher rates of PTSD than men. In these examples, it is quite possible that increased susceptibility to PTSD may simply result from the continuous activation of the HPA axis and sympathetic nervous system experienced by many historically and currently marginalized groups. This may also help explain why childhood trauma also predisposes one to PTSD. The sex-difference in PTSD diagnosis may be a diagnostic reality, but whether it manifests directly due to underlying biological sex-differences or because of endemic socio-cultural realities and stressors that then change the underlying biology has not been effectively addressed. Taken together, the results of this study support the urgency to further understand the extent of PTSD in women and other marginalized groups. Because life-history factors have been shown to mediate susceptibility to PTSD, this

research would benefit all who experience PTSD including combat veterans. Interestingly, an important theme of PTSD clinical research involves resiliency and the suggestion that more resilient groups are less susceptible to PTSD. It's an odd suggestion and not based on data. For example, it is generally thought that four traumatic events predisposes one to PTSD, but in at least one study with Native Americans, that number was six (Gnanadesikan et al., 2005) which might suggest an enhanced resiliency in groups traditionally and currently excluded from full participation in society.

Study of the PTSD comorbidities of pain, addiction, and immune dysfunction support that a better understanding of each comorbidity as it relates to specific trauma type warrants further investigation and may shed light on female victims of sexual assault or other underrepresented groups who experience PTSD. Apart from the disparities in the research which significantly limit treatment of PTSD, the incongruence in research makes it seem as though it is typical to experience PTSD after combat, but atypical to experience PTSD after sexual assault even though as stated previously, it is much more common to experience PTSD after sexual assault than after combat. The socio-cultural implication is that while combat is traumatic, sexual assault is not, and thus, a significant disservice is done to veterans who largely do not experience PTSD and survivors of sexual assault, many of whom do experience PTSD. This contributes to an individual's phenomenological experience depending on the group to which the individual belongs.

The research conducted on veterans contributes to a rich and nuanced understanding of the disease in this population and for those veterans who do experience PTSD, supporting this continued research is essential. However, even the limited research on PTSD in survivors of sexual assault shows us that there are significant differences in the manifestation of the disorder between these two populations. The limited data on survivors of sexual assault with PTSD necessarily limits treatment and understanding of the disease in this population. Focus on comorbidities as linked to the specific trauma type will allow a better understanding of PTSD and facilitate best treatment strategies. A systematic effort must be put forth in the proactive identification of sexual abuse related PTSD in a non-threatening way to ensure that this population is offered the treatment that they need and deserve. This paper serves as a call to address disparities in research that lead to an underrepresentation of those who suffer sexual assault in order to better understand and address the long term biological and psychological impacts of such stressors.

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Endnotes:

^[1] For additional information on the intersectionality of sexual assault in children (boys and girls), those in the LGBTQ+ community, by race, or in-prison or military populations, please see RAINN.org.