The Impact of Posttraumatic Stress Disorder and Moral Injury on Women Veterans' Perinatal Outcomes Following Separation From Military Service

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Abstract

Posttraumatic stress disorder (PTSD) has been found to lead to several adverse perinatal outcomes in the general population. Preliminary research has found that women veterans with PTSD have an increased prevalence of preterm birth, gestational diabetes, and preeclampsia. Less research has examined the role of moral injury (MI) in perinatal outcomes. This longitudinal survey study examined the impact of PTSD symptoms and MI on prospectively assessed adverse perinatal outcomes among women who became pregnant in the first 3 years after separating from U.S. military service ($N = 318$). The Moral Injury Events Scale was used to assess the degree to which individuals experienced distress related to transgressions of deeply held moral beliefs, and the Primary Care PTSD Screen for *DSM-5* (PC-PTSD) was used to assess PTSD symptoms. Perinatal outcomes included experiencing an adverse pregnancy outcome (e.g., preterm birth, gestational diabetes), postpartum depression and/or anxiety, and perceived difficult pregnancy. Although both PTSD symptoms, adjusted odds ratio (aOR) = 1.16, 95% CI [1.00, 1.35]; and MI, aOR = 1.27, 95% CI [1.06, 1.41], emerged as significant predictors of adverse pregnancy outcomes, only PTSD symptoms were a significant predictor of postpartum depression and/or anxiety, aOR = 1.43, 95% CI [1.22, 1.68], and perception of a difficult pregnancy, β = .31, when controlling for lifetime trauma exposure, age, socioeconomic status, and ethnic/racial minority status. The results indicate

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that both PTSD symptoms and MI are associated with adverse perinatal outcomes, supporting the potential need to screen for both PTSD and MI during the perinatal period.

Compared to their civilian counterparts, women veterans are exposed to a wider range and greater frequency of highly stressful and/or traumatic experiences across their lives (Zinzow, Grubaugh, Monnier, Suffoletta-Maierle, & Frueh, 2007). Additionally, women veterans report more significant childhood stressors and early-life histories of trauma exposure (i.e., preenlistment) compared to civilian women (Katon et al., 2015; Zinzow et al., 2007) as well as longer durations of childhood sexual abuse (Schultz, Bell, Naugle, & Polusny, 2006). They also experience more trauma exposure following separation from military service (Dichter, Cerulli, & Bossarte, 2011) and are at risk of experiencing military sexual trauma (MST) and sexual harassment during military service (Street, Gradus, Giasson, Vogt, & Resick, 2013). Moreover, the expansion of roles available to women within the armed services has increased women's exposure to combat, which can involve a variety of potentially traumatic and morally troubling experiences (Street et al., 2013; Vogt et al., 2011).

In turn, these experiences are associated with a range of negative consequences for mental health (Zinzow et al., 2007). Perhaps most notable among these consequences is posttraumatic stress disorder (PTSD), which consists of intrusions, avoidance of trauma-related stimuli, negative alterations in cognitions and mood, and arousal and reactivity that result from trauma exposure (American Psychiatric Association, 2013) and is experienced at an increased rate among women veterans as compared to civilian women (Lehavot et al., 2018). Another potential consequence of both traumatic experiences, such as MST and combat, and nontraumatic experiences, including leadership failures and/or betrayal by peers, the military, or the government, is moral injury, which may result when individuals are confronted with events that violate their sense of right and wrong and lead to reactions including shame, guilt, and demoralization (Drescher, Foy, Kelly, Leshner, Schutz, & Litz, 2011; Frankfurt & Frazier, 2016). Although some researchers conceptualize moral injury as an exposure defined by committing or participating in transgressive acts (Frankfurt & Frazier, 2016), a growing body of research indicates that what is captured by the most widely used measure of moral injury, the Moral Injury Events Scale (MIES), may be better conceptualized as an outcome of exposure to these transgressions (Barnes, Hurley, & Taber, 2019), reflecting moral pain (e.g., guilt and shame) resulting from these experiences (Richardson et al., 2019). Although moral injury and PTSD often co-occur, theoretical models of these two conditions differ (Litz et al., 2009) and have been shown to tap unique neural correlates (Barnes et al., 2019). Posttraumatic stress disorder and its' subsequent treatments are born from etiological models that primarily conceptualize PTSD as a fear-based disorder, whereas moral injury encompasses constructs such as self-blame and spiritual or existential issues that occur following witnessing or participating in events that conflict with deeply held moral beliefs (Litz et al., 2009). As such, there has been an expansion of evidence-based treatments for PTSD to include modules that specifically address moral injury (Maguen & Burkman, 2013). Thus, moral injury is not necessarily a syndromic reaction to exposure and may exist in the absence of a *Diagnostic and Statistical Manual of Mental Disorders* (*DSM*) Criterion A traumatic event.

Both PTSD and moral injury may have implications for pregnancy-related outcomes in women after they leave military service. In the general population, women who enter pregnancy with PTSD are at an increased risk of a variety of negative pregnancy outcomes, including preterm birth, miscarriage, ectopic pregnancy, hyperemesis, low infant birth weight, and postpartum depression (Muzik et al., 2016; Seng, Sampselle, & Graham-Bbermann, 2001; Seng, Low, Sperlich, Ronis, & Liberson, 2011; Seng et al., 2013; Yonkers et al., 2014). A potential mechanism linking PTSD with adverse pregnancy outcomes is dysregulation of the hypothalamic-pituitary axis, which is implicated in both PTSD (Bremner et al., 1997) and preterm birth (McLean, Walters, & Smith, 1993). The literature on perinatal health outcomes among women veterans is still in its infancy, particularly concerning the impact of PTSD on these outcomes. The only studies of which we are aware that have examined the impact of PTSD on pregnancy outcomes among women veterans were conducted by Shaw and colleagues (2014, 2017). In these studies, both of which utilized retrospective Veterans Affairs (VA) data, women with current PTSD during pregnancy were at a significantly increased risk for preterm birth, gestational diabetes, and preeclampsia compared to women with historical or no PTSD during pregnancy (Shaw et al., 2014, 2017).

To our knowledge, no studies in either general or military/veteran populations have examined the impact of moral injury on pregnancy outcomes, yet it is critical to examine the unique effects of these experiences for several reasons. First, as described earlier, theoretical models of PTSD do not clearly translate into theoretical models of moral injury (Litz et al., 2009). Second, there is evidence that moral injury negatively impacts physical health (Yan, 2016), and, therefore, it is likely that moral injury may impact pregnancy-related outcomes. For example, a morally injurious event related to betrayal by leadership or the military may result in loss of trust, which could, in turn, lead to mistrust of healthcare providers' recommendations or how scientific evidence is interpreted, thus resulting in changes in the management of perinatal care.

The number of women in the military and the associated veteran population continues to grow, with the largest increases observed among women of child-bearing age (Frayne et al., 2012; Friedman et al., 2011). Alarmingly, women veterans have been found to be at a higher risk for negative pregnancy-related outcomes as compared to women in the general population (Katon et al., 2014), which underscores the need to better understand the role that PTSD and moral injury play in women veteran's perinatal outcomes. To this end, the primary objective of this study was to examine whether these consequences of highly stressful and/or potentially traumatic events prospectively impact perinatal outcomes during the period following women veterans' initial separation from military service.

Method

Participants and Procedure

Data for this study were obtained from a nationwide prospective cohort study called the Veterans Metrics Initiative (TVMI), which is described in full elsewhere (Vogt et al., 2018). In brief, a sample of 48,965 U.S. veterans who had separated from active duty service or activated reservist status (i.e., at least 180 days) within the last 90 days were invited to

participate in TVMI. Information regarding separating U.S. service members was provided by the VA/Department of Defense (DoD) Identity Repository (VADIR), a VA-managed dataset that included contact information for all veterans, in the fall of 2016.

Using a modified Dillman mail survey approach, which involved multiple contacts and the opportunity to opt out of future communications (Dillman, Smyth, & Christian, 2014), veterans were sent letters inviting them to participate in an online survey. Veterans were first mailed a postcard to introduce the study, followed by a letter that provided instructions on how to participate, then two reminder postcards. A $5 (USD) cash preincentive was included with all invitation letters to increase response rates (Mercer, Caporaso, Cantor, & Townsend, 2015). Individuals who completed the first survey received a $20 electronic gift card. Enrolled participants were invited to complete second, third, fourth, fifth, and sixth surveys, each approximately 6 months apart, using the same methodology, and they were compensated increasing incentives for each survey (i.e., $25 for the second survey, $30 for the third survey, $35 for the fourth survey, $40 for the fifth survey, and $45 for the sixth survey). This study was approved by both VA Boston Healthcare System and ICF International.

Of the 48,965 veterans invited to participate, 4,682 had undeliverable addresses, and two were deceased. Of the 44,281 reachable veterans invited, 9,566 completed the first survey and 581 veterans submitted partial responses, representing a 23.0% response rate. Although this is relatively low, it is consistent with the response rates for other studies done with veterans who served in military operations following the September 11, 2001, terror attacks, for which response rates have ranged from 20% to 30% (Coughlin et al., 2011; Defense Manpower Data Center, 2016). Furthermore, sample characteristics of enrolled participants were similar to the characteristics of the larger population sampled, except regarding paygrade (Vogt et al., 2018). Specifically, veterans with lower paygrades were less likely to participate in the study than those with higher paygrades (Vogt et al., 2018). Only veterans with complete data at the first survey ($N = 9,566$) were included in the final sample and invited to complete follow-up surveys. Women comprised 18.2% ($n = 1,743$) of the sample. Of the women enrolled in the study, 318 (18.2%) reported having had a pregnancy within the 3 years since separation from military service. Sample characteristics are presented in Table 1.

Measures

Demographic and military service–related characteristics—During the first (baseline) survey, women reported on demographic and military characteristics, including age, ethnicity (Hispanic or non-Hispanic), race (Caucasian, African American, Asian, Native American, Middle Eastern, Native Hawaiian/Other Pacific Islander, other), educational attainment (high school, vocational school or some college credit but no degree, associate degree, bachelors/masters/doctorate/professional degree), marital status (never married, married, separated/divorced), household socioeconomic status (SES; no salary, less than $15,000 [USD], $15,000-$34,999, $35,000-$54,999, $55,000-$74,999, $75,000-$99,999, $100,000 or more), employment status (no paid employment, working full or part time), service branch (Army, Navy, Air Force, Marine Corps, National Guard/Reserves), paygrade

(E1–E4, E5–E6, E7–E9, W1–W5/O1–O3, O4–O10), and military occupation (combat arms, combat support, combat service). Given only small reported rates of unique minority race and ethnicity subgroups, race/ethnicity was used in analyses as a dichotomous variable (non-Hispanic White vs. non-White). Participants in the non-White group identified themselves as Hispanic/Latino or a non-Caucasian race.

Lifetime trauma exposure—Lifetime trauma exposure was assessed by asking about trauma exposure during different developmental periods (i.e., prior age 18 years, after age 18 years but before joining the military, during the military, and since separating from military service). A categorical variable (yes or no) was created to reflect any (i.e., yes) versus no endorsement of trauma during one's lifetime. A total of 66.7% of participants ($n = 212$) reported having experienced a traumatic event at some point in their life, with 31.1% reporting exposure before 18 years of age, 22.0% during adulthood but before joining the military, 54.4% during the time in the military, and 9.7% within the past 3 months relative to the Time 1 survey.

PTSD—Posttraumatic stress disorder was assessed at Time 1 using the Primary Care PTSD Screen for *DSM-5* (PC-PTSD-5; Prins et al., 2016). The PC-PTSD is a self-report screening measure for PTSD on which participants indicate ($1 = yes,$ $0 = no$) whether they are experiencing symptoms of reexperiencing, avoidance, negative alterations in cognitions and mood, and hyperarousal, with higher scores representing more symptoms of PTSD. The PC-PTSD-5 has demonstrated excellent diagnostic accuracy, with a score of 3 being the optimally sensitive cutoff score (Prins et al., 2016). Consistent with previous research, participants who denied trauma were given a score of 0 on the PC-PTSD (McClendon, Perkins, Copeland, Finley, & Vogt, 2019), and we examined total PC-PTSD scores in regression equations (e.g., Maguen et al., 2010; Maguen, Luxton, Skopp, & Madden, 2012). The mean participant score was 1.47 ($SD = 1.98$, range: 0–5). Using a cutoff score of 3 or higher, a total of 29.9% ($n = 95$) of participants met the criteria for probable PTSD. The internal consistency reliability of the total PC-PTSD scale was good, Cronbach's $\alpha = .89$.

Moral injury—Moral injury was assessed at Time 2 using the MIES (Nash et al., 2013). The MIES is a nine-item measure on which respondents use a 6-point scale, ranging from 1 (*strongly disagree*) to 6 (*strongly agree*), to indicate the degree to which they agree with statements that assess transgressions of deeply held moral beliefs while in the military (e.g., "I am troubled by having acted in ways that violated my own moral code or values"), with higher scores indicating more severe moral injury. The MIES has demonstrated excellent internal consistency reliability, temporal stability, and good construct validity (Nash et al., 2013). In the current sample, the mean MIES score was 20.85 ($SD = 11.35$, range: 9–54), and the internal consistency reliability of this measure was high, Cronbach's $\alpha = .82$.

Perinatal outcomes—Perinatal outcomes were assessed in the second, third, fourth, fifth, and sixth follow-up surveys to capture pregnancies that occurred within the 3 years since separating from military service. Drawing from the literature on adverse pregnancy outcomes (Witt, Wisk, Cheng, Hampton, & Hagen, 2012), participants were asked to report if they had experienced a pregnancy since separating from military service and whether they

experienced any of the following outcomes (*yes* or *no*) during or after that pregnancy: miscarriage; stillbirth; birth prior to 37 weeks gestational age; ectopic/tubal pregnancy; emergency Caesarean section (C-section); high blood pressure, gestational diabetes, or other medical condition present only during pregnancy; or a baby that required a stay in the neonatal intensive care unit (NICU) following birth. Low base rates of individual pregnancy outcomes prohibited the ability to look at outcomes individually. However, the extant literature suggests that PTSD is associated with this broad range of perinatal outcomes (Muzik et al., 2016; Seng et al., 2001, 2011, 2013; Shaw et al., 2014, 2017; Yonkers et al., 2014). Therefore, participants who reported any of these events during any pregnancy since separation from military service were categorized as having experienced an adverse pregnancy outcome, which is a strategy that has been employed by other researchers conducting similar studies (e.g., Witt et al., 2012). Participants were also asked to report whether experienced postpartum depression and/or anxiety after any of their pregnancies since separation from military service (*yes* or *no*). A total of 51.3% of the sample experienced an adverse pregnancy outcome, with miscarriage being the most common (24.8%), followed by obstetric medical conditions such as preeclampsia or gestational diabetes (22.0%), an emergency C-section (8.5%), preterm birth (5.7%), having a baby in the NICU (7.9%), ectopic or tubal pregnancy (1.9%), and stillbirth (1.9%). A total of 29.6% of participants reported experiencing postpartum depression and/or anxiety. Participants were also asked to rate how they subjectively experienced their pregnancy, using a 5-point scale ranging from 1 (*very easy*) to 5 (*very difficult*), with higher scores representing the perception of a more difficult pregnancy. The average subjective pregnancy experience was described as neutral ($M = 3.08$, $SD = 1.11$). Therefore, the main perinatal outcome variables were: (a) experiencing an adverse pregnancy outcome, (b) postpartum depression and/or anxiety, and (c) perception of a difficult pregnancy.

Data Analysis

All analyses were performed using SPSS (Version 26). First, Spearman's rho correlations were conducted between all variables included in the regression equations. Then, PC-PTSD total scores and MIES total scores were fitted into two logistic regressions and one linear regression to assess the unique variance of PTSD symptoms and moral injury in the prediction of adverse pregnancy outcomes (Model 1), postpartum depression/anxiety (Model 2), and perception of a difficult pregnancy (Model 3). Potential confounders included age, racial/ethnic minority status, and SES, which are factors that strongly predict negative perinatal outcomes. All reported results have been adjusted for these potential confounders. Furthermore, to partial out the effect of trauma exposure in and of itself versus the emotional consequence of potential trauma exposure, lifetime trauma exposure was also included as a covariate in each of the three models. Because PC-PTSD and moral injury total scores were entered into the regression models, the estimated adjusted odds ratios (a*OR*s) represent the change in risk of adverse pregnancy outcomes and postpartum depression/anxiety for a 1-point change in PTSD and moral injury total scores, which we would expect to be smaller given the range in the scales. The possible score range for the PC-PTSD is 0–5; thus, a 1-point change on this measure is clinically meaningful as it represents the endorsement of an additional cluster of PTSD symptoms. For the MIES, however, scores range from 9 to 54, meaning that 1-point score change on this measure is not clinically significant. To better

understand the odds of experiencing an adverse pregnancy outcome and postpartum depression/anxiety among women with more severe symptoms of moral injury, we calculated the odds ratio for a 6-point change in MIES total score, which is equivalent to fully endorsing (i.e., *strongly agree*) one additional item on this scale, similar to the PC-PTSD scale. Only women who completed the PC-PTSD and MIES were included in the analyses ($N = 318$). There were no missing data on pregnancy outcomes.

Demographic factors did not vary significantly for women who had adverse pregnancy outcomes as compared to women who did not have adverse pregnancy outcomes. However, women who self-reported postpartum depression and/or anxiety were more likely than those without these conditions to have served in combat support or service support roles (37.2% and 25.8%, respectively) as compared to a combat arms–related role (15.4%). A series of sensitivity analyses were conducted to examine whether the associations between PTSD symptoms and moral injury and perinatal outcomes were sustained after adjusting for other potential confounders that were not included in the model. Specifically, we ran models with the addition of primary military occupational status given that this characteristic was found to differ among women with postpartum depression and/or anxiety in our sample. We also ran models that included the number of deployments, as this has been found to predict preterm birth among active duty female soldiers (Shaw et al., 2018). Finally, we ran models that included health insurance status, as this may impact access to prenatal and mental health care. To address the limitation of combining all pregnancy-related outcomes, including maternal and infant outcomes, into one outcome variable (any vs. never), we also reran the model after removing NICU stay from the adverse pregnancy variable.

Results

Effect of PTSD and Moral Injury on Perinatal Outcomes

Table 2 presents Spearman correlations among all variables included in the regression equations. Minority status, SES, and trauma exposure were all significantly associated with PTSD symptoms and moral injury, rs = .11–.57, such that racial/ethnic minority women, women of lower SES, and women who experienced a traumatic event were more likely to report a higher level of PTSD symptoms and more severe moral injury. Racial/ethnic minority status and SES were not related to any of the perinatal outcomes. Older age was associated with lifetime trauma exposure, $r = .11$; and adverse pregnancy outcome, $r = .13$. Lifetime trauma exposure was associated with postpartum depression and/or anxiety, $r = .21$, as well as the perception of a difficult pregnancy, $r = .12$. Symptoms of PTSD and moral injury were associated with all three perinatal outcomes, rs = .15–.35.

Logistic and linear regression results of the unique effects of PTSD symptoms and moral injury on adverse pregnancy outcomes, postpartum depression and anxiety, and pregnancy experiences are presented in Table 3. Both PTSD symptoms, aOR = 1.16, 95% CI [1.00, 1.35], and moral injury, aOR = 1.27, 95% CI [1.06, 1.41], significantly predicted an increased risk of an adverse pregnancy outcome, after adjusting for age, racial/ethnic minority status, SES, and lifetime trauma exposure. Alternatively, only PTSD symptoms significantly predicted an increased risk of experiencing postpartum depression and anxiety, aOR = 1.43, 95% CI [1.22, 1.68], and perception of a difficult pregnancy, $t(312) = 4.55$, β

= .31, p = .000, after controlling for age, minority status, SES, and trauma exposure. It is important to note that due to the positive skew in moral injury scores in this sample, the assumption of linearity of independent variables and log odds was violated for the logistic regression model that focused on postpartum depression and/or anxiety. We log-transformed moral injury and reran the regression model, and the association between moral injury and postpartum mental health remained insignificant. For ease of interpretation of the odds ratio and consistency of interpretation between moral injury and PTSD symptoms and across the two regression models, we have retained the model that presents the untransformed moral injury variable in the manuscript.

The analyses that examined factors predicting perception of a difficult pregnancy revealed that the predictor variables accounted for 10% of the overall variance, $F(6, 310) = 5.76$, $p < .001$. Step 1 of the model, which included age, minority status, SES, and lifetime trauma exposure, did not account for significant variance in a women's subjective experience of pregnancy. Step 2 of the model, which also included PTSD symptoms and moral injury, accounted for 8% of unique variance, with only increased PTSD symptoms emerging as predictive of the perception of a difficult pregnancy, $t(312) = 4.55$, $\beta = .31$, $p = .000$ (see Table 3) above and beyond age, racial/ethnic minority status, SES, and lifetime trauma exposure. These results remained robust across all sensitivity analyses (results not shown).

Discussion

The current study was the first of which we are aware to prospectively examine the associations between PTSD symptoms and moral injury and perinatal outcomes among recently separated women veterans. Both PTSD symptoms and moral injury emerged as unique predictors of an increased risk of adverse pregnancy outcomes. Specifically, more severe PTSD symptoms and higher ratings of moral injury prospectively predicted an increased likelihood of having an adverse pregnancy outcome. Alternatively, only PTSD symptoms emerged as a significant predictor of postpartum depression and/or anxiety and perception of a difficult pregnancy, such that women with higher levels of PTSD symptoms were more likely to report having postpartum depression and anxiety and to describe their pregnancy as being more difficult.

The results regarding PTSD are consistent with what has been reported in other studies that have examined the association between PTSD and adverse pregnancy outcomes among veterans (Shaw et al., 2014, 2017). These findings are also in line with literature documenting increased postpartum mental health problems among women with perinatal PTSD in the general population (Muzik et al., 2016). Whereas other studies have not examined the impact of moral injury on pregnancy outcomes, the present findings concerning moral injury are consistent with literature demonstrating that increased ratings of moral injury are associated with a range of deleterious outcomes, including increased odds of suicidal ideation and suicide attempts (Wisco et al., 2017) and poorer physical health (Yan, 2016) among both men and women veterans. In the present study, PTSD symptoms and moral injury were moderately correlated ($r = .40$), suggesting related but unique constructs.

The present findings also revealed that rates of adverse pregnancy outcomes differed from those observed in the general population and other veteran samples. At 5.7%, the rate of preterm birth in the current sample was lower than the 12% rate found in the general U.S. population (Blencowe et al., 2012) but similar to the prevalence of preterm birth in active duty female soldiers (Shaw et al., 2018). The rate of miscarriage was higher in the present sample (24.8%) compared to the rate found in the general population (12%–15%; Garcia-Enguidanos, Calle, Valero, Luna, & Dominguez-Rojas, 2002). Additionally, 22.0% of women in the present sample reported a medical condition only present during pregnancy, such as high blood pressure or gestational diabetes, whereas rates of preeclampsia and gestational diabetes have been reported to be between 5% and 10% in other large studies of women veterans (Katon et al., 2014; Shaw et al., 2017). These differences are not surprising, as this study differed from other larger cohort studies in several ways. First, the present study focused on a small subsample of women who happened to become pregnant within the first 3 years following military service, and there may be unique risk and/or protective factors that impact pregnancy during this early separation period. In addition, methodological differences in the assessment of perinatal outcomes may have also contributed to differences in the prevalence of these outcomes. For example, although we asked women to report if they had given birth prior to 37 weeks gestational age, some women may not have accurately remembered the exact gestational age when they delivered. Additionally, women were asked if they experienced high blood pressure, gestational diabetes, or other medical conditions only present during pregnancy, and, therefore, may have reported on medical conditions that developed during pregnancy outside of gestational diabetes and high blood pressure.

The results of the current study extend knowledge of the effects of PTSD and moral injury on veterans' health by documenting the impact that these experiences have on a broad range of women's perinatal health outcomes. The finding that lifetime trauma exposure did not significantly predict any perinatal outcome when PTSD symptoms and moral injury were included in the model suggests that reactions to these events in the form of PTSD symptoms and, potentially, moral injury may be more impactful in predicting perinatal outcomes than the events themselves. This is consistent with literature that has found that the association between trauma exposure and physical health is largely explained by the presence and severity of mental health symptoms, such as those associated with PTSD (Green & Kimerling, 2004).

This was the first study, to our knowledge, to examine the unique impact of PTSD symptoms and moral injury on prospectively assessed perinatal outcomes among women veterans in the period following separation from military service. Additionally, this was the only study of which we are aware that examined postpartum depression and anxiety as well as subjective experiences of pregnancy among veterans. The strengths of the study include the focus on a population-based sample of newly separated veterans and the prospective assessment of perinatal outcomes among a large sample of women who became pregnant soon after separating from the military. There were also limitations that must be considered. First, PTSD symptoms, moral injury, and perinatal outcomes were assessed using self-report measures, which rely on a respondent's perceptions and memory and may be subject to some level of response bias. Furthermore, we utilized the PC-PTSD to assess PTSD

symptoms. Further research that examines the impact of PTSD using the full range of PTSD symptoms assessed by the Posttraumatic Stress Disorder Checklist for *DSM-5* (PCL-5; Blevins, Weathers, Davis, Witte, & Domino, 2015) will be important. Second, we relied on a single item to ascertain the occurrence of postpartum depression and/or anxiety, thus limiting our ability to examine the range and type of potential postpartum mental health problems experienced by these women as well as the associations between PTSD symptoms and moral injury and these outcomes. Third, due to the low base rate of some of the measured perinatal outcomes (e.g., stillbirth) and small racial and ethnic subgroups, we utilized a combined indicator of adverse pregnancy outcomes and, thus, could not examine unique effects on different types of adverse pregnancy outcomes and were unable to examine differences in outcomes by unique minority subgroups (e.g., Black vs. Hispanic). Fourth, although this study adjusted for many well-established variables that influence perinatal outcomes, unmeasured factors, such as medication use, substance use, chronic health conditions, and use of prenatal care, may have impacted associations. Fifth, it is possible that in some women who experienced a pregnancy within the first 3 months after separation, PTSD symptoms could have reflected reactions to adverse pregnancy outcomes. Finally, the larger TVMI study had a relatively low response rate of 23%, which may decrease the generalizeability of the findings despite the fact that sample characteristics in the larger TVMI study were similar to the characteristics of the larger population sampled, with the exception of paygrade.

The new VA/DoD clinical practice guidelines on pregnancy management published in March 2018 (VA/DoD, 2018) incorporate the importance of screening for mental health conditions regularly during pregnancy, as well as the coordination of care between medical and mental health providers, to prevent adverse perinatal outcomes. Although depression screening has become more common in obstetric settings following the recent U.S. Preventative Services Task Force recommendation that all adults, including pregnant and postpartum women, be screened for depression (Siu et al., 2016), it is unlikely that screening for PTSD and moral injury are being conducted in these settings. However, our findings support the notion that increased screening for PTSD and moral injury, as well as access to treatment for these problems, is warranted.

Acknowledgments

References

American Psychiatric Association. (2013). Diagnostic and statistical manual of mental disorders (5th ed.). Arlington, VA: Author.

Barnes HA, Hurley RA, & Taber KH (2019). Moral injury and PTSD: Often co-occurring yet mechanistically different. Journal of Neuropsychiatry and Clinical Neurosciences, 31, A4–103. 10.1176/appi.neuropsych.19020036

Blencowe H, Cousens S, Oestergaard MZ, Chou D, Moller AB, Narwal R, … Lawn JE (2012). National, regional, and worldwide estimates of preterm birth rates in the year 2010 with time trends since 1990 for selected countries: A systematic analysis and implications. The Lancet, 379, 2162–2172. 10.1016/S0140-6736(12)60820-4

Blevins CA, Weathers FW, Davis MT, Witte TK, & Domino JL (2015). The Posttraumatic Stress Disorder Checklist for DSM-5 (PCL-5): Development and initial psychometric evaluation. Journal of Traumatic Stress, 28, 489–498. 10.1002/jts.22059 [PubMed: 26606250]

Bremner JD, Licinio J, Darnell A, Krystal JH, Owens MJ, Southwick SM, … Charney DS (1997). Elevated CSF corticotropin-releasing factor concentrations in posttraumatic stress disorder. American Journal of Psychiatry, 154, 624–629. 10.1176/ajp.154.5.624

Coughlin SS, Aliaga P, Barth S, Eber SM, Maillard JD, Mahan CM,… Williams M (2011). The effectiveness of a monetary incentive on response rates in a survey of recent U.S. Veterans. Survey Practice, 4 10.29115/SP-2011-0004

Defense Manpower Data Center (DMDC), Research, Surveys, and Statistics Center (RSSC). (2016). Status of forces surveys of active duty members (2013 & 2014 SOFS-A): Briefing on leading indicators, Military OneSource, financial health, family life, access to technology, impact of deployments, and permanent change of station (PCS) moves. https://download.militaryonesource.mil/12038/MOS/Reports/SOFS-A_Briefing_20160311.pdf.

Dichter ME, Cerulli C, & Bossarte RM (2011). Intimate partner violence victimization among women veterans and associated heart health risks. Women's Health Issues, 21, S190–S194. 10.1016/j.whi.2011.04.008 [PubMed: 21724140]

Dillman DA, Smyth JD, & Christian LM (2014). Internet, mail, and mixed-mode surveys: The tailored design method (4th ed.). Hoboken, NJ: Wiley.

Drescher KD, Foy DW, Kelly C, Leshner A, Schutz K, & Litz B (2011). An exploration of the viability and usefulness of the construct of moral injury in war veterans. Traumatology, 17, 8–13. 10.1177/1534765610395615

Frankfurt S, & Frazier P (2016). A review of research on moral injury in combat veterans. Military Psychology, 28, 318–330. 10.1037/mil0000132

Frayne S, Phibbs C, Friedman S, Saechao F, Berg E, Balasubramanian V, … Haskell S (2012). Sourcebook: women veterans in the Veterans Health Administration. Volume 2 Sociodemographics and Use of VHA and non-VA care (fee). Washington, DC: Women's Health Evaluation Initiative, Women's Health Services, Veterans Health Administration, Department of Veterans Affairs.

Friedman SA, Phibbs CS, Schmitt SK, Hayes PM, Herrera L, & Frayne SM (2011). New women veterans in the VHA: A longitudinal profile. Women's Health Issues, 21, S103–S111. 10.1016/j.whi.2011.04.025 [PubMed: 21724129]

Garcia-Enguidanos A, Calle ME, Valero J, Luna S, & Dominguez-Rojas V (2002). Risk factors in miscarriage: A review. European Journal of Obstetrics & Gynecology and Reproductive Biology, 102, 111–119. 10.1016/S0301-2115(01)00613-3 [PubMed: 11950476]

Green BL, & Kimerling R (2004). Trauma, posttraumatic stress disorder, and health status In Schnurr PP & Green BL (Eds.), Trauma and health: Physical health consequences of exposure to extreme stress (pp. 13–44). Washington, D.C.: American Psychological Association 10.1037/10723-002

Katon JG, Lehavot K, Simpson TL, Williams EC, Barnett SB, Grossbard JR, … Reiber GE (2015). Adverse childhood experiences, military service, and adult health. American Journal of Preventive Medicine, 49, 573–582. 10.1016/j.amepre.2015.03.020 [PubMed: 26091925]

Katon JG, Mattocks K, Zephyrin L, Reiber G, Yano EM, Callegari L, … Haskell S (2014). Gestational diabetes and hypertensive disorders of pregnancy among women veterans deployed in service of operations in Afghanistan and Iraq. Journal of Womens Health, 23, 792–800. 10.1089/jwh.2013.4681

Lehavot K, Goldberg SB, Chen JA, Katon JG, Glass JE, Fortney JC, … Schnurr PP (2018). Do trauma type, stressful life events, and social support explain women veterans' high prevalence of PTSD?

Social Psychiatry and Psychiatric Epidemiology, 53, 943–953. 10.1007/s00127-018-1550-x [PubMed: 29936598]

Litz BT, Stein N, Delaney E, Lebowitz L, Nash WP, Silva C, & Maguen S (2009). Moral injury and moral repair in war veterans: A preliminary model and intervention strategy. Clinical Psychology Review, 29, 695–706. 10.1016/j.cpr.2009.07.003 [PubMed: 19683376]

Maguen S, & Burkman K (2013). Combat-related killing: Expanding evidence-based treatments for PTSD. Cognitive and Behavioral Practice, 20, 476–479. 10.1016/j.cbpra.2013.05.003

Maguen S, Lucenko BA, Reger MA, Gahm GA, Litz BT, Seal KH, … Marmar CR (2010). The impact of reported direct and indirect killing on mental health symptoms in Iraq war veterans. Journal of Traumatic Stress, 23, 86–90. 10.1002/jts.20434 [PubMed: 20104592]

Maguen S, Luxton DD, Skopp NA, & Madden E (2012). Gender differences in traumatic experiences and mental health in active duty soldiers redeployed from Iraq and Afghanistan. Journal of Psychiatric Research, 46, 311–316. 10.1016/j.jpsychires.2011.11.007 [PubMed: 22172997]

McLean M, Walters WA, & Smith R (1993). Prediction and early diagnosis of preterm labor: A critical review. Obstetrical and Gynecological Survey, 48, 209–225. 10.1097/00006254-199304000-00001 [PubMed: 8474759]

McClendon J, Perkins D, Copeland LA, Finley EP, & Vogt D (2019). Patterns and correlates of racial/ ethnic disparities in posttraumatic stress disorder screening among recently separated veterans. Journal of Anxiety Disorders, 68, 102145 10.1016/j.janxdis.2019.102145 [PubMed: 31550626]

Mercer A, Caporaso A, Cantor D, & Townsend R (2015). How much gets you how much? Monetary incentives and response rates in household surveys. Public Opinion Quarterly, 79, 105–129. 10.1093/poq/nfu059

Muzik M, McGinnis EW, Bocknek E, Morelen D, Rosenblum KL, Liberzon I, … Abelson JL (2016). PTSD symptoms across pregnancy and early postpartum among women with lifetime PTSD diagnosis. Depression and Anxiety, 33, 584–591. 10.1002/da.22465 [PubMed: 26740305]

Nash WP, Marino Carper TL, Mills MA, Au T, Goldsmith A, & Litz BT (2013). Psychometric evaluation of the Moral Injury Events Scale. Military Medicine, 178, 646–652. 10.7205/MILMED-D-13-00017 [PubMed: 23756071]

Prins A, Bovin MJ, Smolenski DJ, Marx BP, Kimerling R, Jenkins-Guarnieri MA, … Tiet QQ (2016). The Primary Care PTSD Screen for DSM-5 (PC-PTSD-5): Development and evaluation within a veteran primary care sample. Journal of General Internal Medicine, 31, 1206–1211. 10.1007/s11606-016-3703-5 [PubMed: 27170304]

Richardson CB, Chesnut RP, Morgan NR, Bleser JA, Perkins DF, Vogt D, … Finley E (2019). Examining the Factor Structure of the Moral Injury Events Scale in a Veteran Sample Military Medicine. Advance online publication 10.1093/milmed/usz129

Schultz JR, Bell KM, Naugle AE, & Polusny MA (2006). Child sexual abuse and adulthood sexual assault among military veteran and civilian women. Military Medicine, 171, 723–728. 10.7205/MILMED.171.8.723 [PubMed: 16933812]

Seng JS, Low LK, Sperlich M, Ronis DL, & Liberzon I (2011). Posttraumatic stress disorder, child abuse history, birth weight, and gestational age: A prospective cohort study. BJOG, 118, 1329–1339. 10.1111/j.1471-0528.2011.03071.x. [PubMed: 21790957]

Seng JS, Sampselle CM, & Graham-Bermann S (2001). Posttraumatic stress disorder and pregnancy complications. Obstetrics and Gynecology, 97, 17–22. 10.1016/S0029-7844(00)01097-8 [PubMed: 11152900]

Seng JS, Sperlich M, Low LK, Ronis DL, Muzik M, & Liberzon I (2013). Childhood abuse history, posttraumatic stress disorder, postpartum mental health and bonding: A prospective cohort study. Journal of Midwifery & Womens Health, 58, 57–68. 10.1111/j.1542-2011.2012.00237.x.

Shaw JG, Asch SM, Katon JG, Shaw KA, Kimerling R, Frayne SM, & Phibbs CS (2017). Posttraumatic stress disorder and antepartum complications: A novel risk factor for gestational diabetes and preeclampsia. Paediatric and Perinatal Epidemiology, 31, 185–194. 10.1111/ppe.12349 [PubMed: 28328031]

Shaw JG, Asch SM, Kimerling R, Frayne SM, Shaw KA, & Phibbs CS (2014). Posttraumatic stress disorder and risk of spontaneous preterm birth. Obstetrics & Gynecology, 124, 1111–1119. 10.1097/AOG.0000000000000542 [PubMed: 25415162]

Shaw JG, Nelson DA, Shaw KA, Woolaway-Bickel K, Phibbs CS, & Kurina LM (2018). Deployment and preterm birth among U.S. Army soldiers. American Journal of Epidemiology, 187, 687–695. 10.1093/aje/kwy003 [PubMed: 29370332]

Siu AL, Bibbins-Domingo K, Grossman DC, Baumann LC, Davidson KW, Ebell M, … Krist AH (2016). Screening for depression in adults: U.S. Preventive Services Task Force recommendation statement. JAMA, 315, 380–387. 10.1001/jama.2015.18392 [PubMed: 26813211]

Street AE, Gradus JL, Giasson HL, Vogt D, & Resick PA (2013). Gender differences among veterans deployed in support of the wars in Afghanistan and Iraq. Journal of General Internal Medicine, 28, 556–562. 10.1007/s11606-013-2333-4

U.S. Department of Veterans Affairs and U.S. Department of Defence. (2018). VA/DoD clinical practice guideline for the management of PTSD. Retrieved from https://www.healthquality.va.gov/guidelines/MH/ptsd/VADoDPTSDCPGFinal012418.pdf

Vogt DS, Perkins DF, Copeland LA, Finley EP, Jamieson CS, Booth B, … Gilman CL (2018). The Veterans Metrics Initiative study of U.S. veterans' experiences during their transition from military service. BMJ Open, 8, 1–10. 10.1136/bmjopen-2017-020734

Vogt DS, Vaughn R, Glickman ME, Schultz M,L, , Drainoni M,Elwy R, & Eisen S(2011). Gender differences in combat related stressors and their association with postdeployment mental health in a nationally representative sample of U.S. OEF/OIF veterans. Journal of Abnormal Psychology, 120, 797–806. 10.1037/a0023452 [PubMed: 21639595]

Wisco BE, Marx BP, May CL, Martini B, Krystal JH, Southwick SM, & Pietrzak RH (2017). Moral injury in U.S. combat veterans: Results from the National Health and Resilience in Veterans Study. Depression and Anxiety, 34, 340–347. 10.1002/da.22614

Witt WP, Wisk LE, Cheng ER, Hampton JM, & Hagen EW (2012). Preconception mental health predicts pregnancy complications and adverse birth outcomes: A national population-based study. Maternal Child Health Journal, 16, 1525–1541. 10.1007/s10995-011-0916-4 [PubMed: 22124801]

Yan GW (2016). The invisible wound: Moral injury and its impact on the health of OEF/OIF veterans. Military Medicine, 181, 451–458. 10.7205/MILMED-D-15-00103 [PubMed: 27136652]

Yonkers KA, Smith MV, Forray A, Epperson CN, Costello S, Lin H, & Belanger K (2014). Pregnant women with posttraumatic stress disorder and risk of preterm birth. JAMA Psychiatry, 71, 897–904. 10.1001/jamapsychiatry.2014.558 [PubMed: 24920287]

Zinzow HM, Grubaugh AL, Monnier J, Suffoletta-Maierle S, & Frueh BC (2007). Trauma among female veterans: A critical review. Trauma, Violence & Abuse, 8, 384–400. 10.1177/1524838007307295

Table 1

Participant Demographics and Background Characteristics

Variable	M	SD
Age (years)	27.99	5.27
	n	%
Ethnicity		
Hispanic/Latino	47	14.8
Non-Hispanic	271	85.2
Race		
Caucasian	243	76.4
African American	54	17.0
Asian	7	2.2
Native American	15	4.7
Native Hawaiian/Other Pacific Islander	8	2.5
Other	18	5.7
Minority Status		
Non-Hispanic White	198	62.3
Non-White	120	37.7
Marital Status		
Never married	45	14.2
Married	228	71.7
Separated/divorced	45	14.2
Educational attainment		
High school degree	49	15.4
Vocational/some college credit	110	34.6
Associates degree	42	13.2
Bachelor's degree	61	19.2
Masters/doctorate/professional degree	56	17.6
Total annual household income (USD)		
No salary	16	5.0
< $15,000	30	9.4
$15,000–$34,999	74	23.3
$35,000–$54,999	78	23.5
$55,000–$74,999	42	13.3
$75,000–$99,999	36	11.3
$100,000	42	13.2
Employment		
No paid employment	88	27.7
Working part time or full time	118	37.1
Not working but looking	112	35.2
Service branch		

Variable	M	SD
Army	106	33.3
Navy	73	23.0
Air Force	73	23.0
Marine Corps	32	10.1
National Guard/Reserves	34	10.7
Service paygrade		
E1–E4 junior enlisted	144	45.3
E5–E6 Midgrade enlisted	87	27.4
E7–E9 senior enlisted	14	4.4
W1–W5 O1–O3 warrant/junior officer	50	15.7
O4–O10 senior officer	23	7.2
Military occupation		
Combat arms	26	8.2
Combat support	129	40.6
Service support	163	51.3
Adverse pregnancy outcome		
No	155	48.7
Yes	163	51.3
Postpartum depression and/or anxiety		
No	224	70.4
Yes	94	29.6

Note. N = 318.

Table 2

Correlations Between Covariates, Exposure, and Outcome Variables

Variable	1	2	3	4	5	6	7	8	9	Observed Range
1. Racial/ethnic minority status [a]	-	−.04	−.31 ***	.00	.16 *	.18 *	−.06	.04	.03	0–1
2. Age		-	.50 ***	.11 *	.05	.04	.13 *	−.03	.05	20–46
3. Socioeconomic status			-	−.04	−.11 *	−.11 *	.02	−.05	−.04	0–9
4. Trauma exposure [b]				-	.57 ***	.28 ***	.09	.21 ***	.12 *	0–1
5. PTSD symptoms (PC-PTSD)					-	.40 ***	.18 *	.35 ***	.29 ***	0–5
6. Moral injury (MIES)						-	.20 ***	.24 ***	.15 *	9–54
7. Adverse pregnancy outcome							-	.22 ***	.28 ***	0–1
8. Postpartum mental health								-	.21 ***	0–1
9. Perception of pregnancy [c]									-	1–5

Note. PC-PTSD = Primary Care Posttraumatic Stress Disorder (PTSD) Screen; MIES = Moral Injury Events Scale.

[a] 0 = White, Not Hispanic, 1 = Minority.

[b] 0 = no lifetime history of trauma exposure, 1 = lifetime history of trauma exposure.

[c] Scored on a scale of 1 (*very easy*) to 5 (*very difficult*).

*
$p < .05$.

***
$p < .001$.

Table 3

Regression Models Examining the Effects of PTSD and Moral Injury on Perinatal Outcomes

	Adverse Pregnancy Outcomes		Postpartum Depression and/or Anxiety		Perception of Pregnancy	
	aOR	95% CI	aOR	95% CI	β	R^2
						.10 ***
Age	1.06 *	[1.00, 1.12]	0.97	[0.92, 1.03]	.05	
Racial/ethnic minority status	0.58 *	[0.34, 0.97]	0.86	[0.48, 1.54]	−.04	
Socioeconomic status	0.95	[0.85, 1.06]	1.00	[0.88, 1.13]	−.03	
Lifetime trauma exposure	0.79	[0.44, 1.40]	1.19	[0.58, 2.45]	−.06	
PTSD	1.16 *	[1.00, 1.35]	1.43 ***	[1.22, 1.68]	.31 ***	
Moral injury [a]	1.27 **	[1.06, 1.41]	1.10	[0.95, 1.27]	.07	

Note. a*OR* = adjusted odds ratio.

[a] *OR* represents a 6-point change in moral injury.

*
 p < .05.

**
 p < .01.

***
 p < .001.