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Adversity and Trauma Exposure and Related Consequences for Women's Health Across the Lifespan

Author

Thomas, Jordan Leigh

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Adversity and Trauma Exposure and Related Consequences for Women's Health Across the Lifespan

A dissertation submitted in partial satisfaction of the

requirements for the degree Doctor of Philosophy

in Psychology

by

Jordan Thomas

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ABSTRACT OF THE DISSERTATION

Adversity and Trauma Exposure and Related Consequences for Women's Health Across the Lifespan

by

Jordan Thomas

Doctor of Philosophy in Psychology

University of California, Los Angeles, 2024

Professor Jennifer A. Sumner, Chair

Trauma and its psychological consequences—including posttraumatic stress disorder (PTSD), the signature stress-related psychopathology—are linked with adverse mental, physical, and sexual health in women. Examining associations between trauma-related factors and pertinent health markers at discrete periods of the lifespan may reveal potential mechanisms and intervention targets. Toward that end, this dissertation utilized a three-study design to investigate associations between trauma and related psychopathology and relevant women's health indicators during adolescence, the perinatal period, and midlife. Study 1 evaluated whether distinct dimensions of early life adversity—including threat (e.g., abuse) and deprivation (e.g., neglect)—were differentially linked with sexual behavior in a national sample of adolescents. While greater experiences of both threat and deprivation were linked with elevated odds of engagement in sex, experiences of threat were uniquely linked with diverse indicators of sexual

risk behavior (e.g., earlier age at first sex, greater number of past-year partners, inconsistent condom use). Study 2 examined associations between couple-level manifestations of PTSD symptoms and maternal and paternal relationship functioning in a community-based sample of couples during the postpartum period. Using both data- and hypothesis-driven approaches, unique subgroups of couples—based on both partners' PTSD symptoms—were identified, including dyads characterized by concordance in PTSD symptoms (e.g., *both low*) and discordance (e.g., *mother low—father high*, *mother low—father high*). Across the two dyad classification methods, couple-level PTSD manifestations were differentially linked with subjective and objective indicators of relationship functioning, with individuals in couples concordant in reporting low PTSD symptoms exhibiting the most optimal relationship health. Study 3 investigated the underlying dimensional structure of PTSD—and associations between emergent symptom dimensions and menopause-related health indicators—in a sample of midlife women veterans. PTSD was best captured by six symptom dimensions, with greater symptoms across all factors linked with urinary and vasomotor, but not vaginal, symptoms; negative affect and dysphoric arousal emerged as particularly relevant to these menopause- and aging-related symptoms. Greater PTSD symptoms across dimensions were also linked with markers of sexual dysfunction. Taken together, these studies emphasize the role of trauma-related factors on diverse women's health metrics across the lifespan.

The dissertation of Jordan Thomas is approved.

Christine Dunkel Schetter

Annette L. Stanton

Carolyn J. Gibson

Jennifer A. Sumner, Committee Chair

University of California, Los Angeles

2024

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Acknowledgements

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Thomas, J.L., Somers, J.A., Dunkel Schetter, C., & Sumner, J.A. (2024). Couple-level manifestations of posttraumatic stress disorder and maternal and paternal postpartum relationship functioning. *Depression and Anxiety*. doi:10.1155/2024/6140465

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Jordan L. Thomas, M.A., C.Phil.

EDUCATION

University of California, Los Angeles, Los Angeles, CA — Fall 2018 - Summer 2024
Doctor of Philosophy Candidate, Clinical Psychology — *(expected)*
Master of Arts, Clinical Psychology — Spring 2020

Connecticut College, New London, CT — Spring 2015
Bachelor of Arts, Psychology (Honors and Distinction)

SELECTED HONORS AND AWARDS

2022	Distinguished Student Scientist-Practitioner Award, Society for Clinical Psychology (APA Division 12) and Council of University Directors of Clinical Psychology
2021-2023	T32 Fellowship (Biobehavioral Issues in Physical and Mental Health), NIMH
2021	Clinical Psychology Area Clinical Scientist Award, UCLA
2021	Henry P. David Grant for Reproductive Behavior Research, American Psychological Foundation
2021	Center for the Study of Women, Elizabeth Blackwell MD Award, UCLA
2020, 2021	Graduate Division Graduate Summer Research Mentorship, UCLA
2018-2019	Graduate Research Scholarship, Psi Chi National Honors Society in Psychology
2015	Honorary Undergraduate Scholar, New England Psychological Association
2015	Winthrop Scholar (top 3% of graduating class) and Phi Beta Kappa, Connecticut College
2015	Psychology Department Prize for Service and Dedication, Connecticut College
2013	Psi Chi National Honor Society in Psychology, Connecticut College
2013	John R. Mackinnon Prize (Outstanding Performance in Psychology), Connecticut College

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1. **Thomas, J.L.,** & Dunkel Schetter, C. (2023). Postpartum depression and adjustment. In: Friedman H, Markey C, eds. *Encyclopedia of Mental Health,* 3rd edition.

2.**Thomas, J.L.,** Colich, N.L., McLaughlin, K.A., & Sumner, J.A. (2023). Dimensions of early adversity and sexual behavior in a U.S. population-based adolescent sample. *Journal of Adolescent Health*, *72*(4), 560-567.

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18. **Thomas, J.L.**, & Ickovics, J.R. (2017). Women's health communication: High-risk pregnancy and premature birth narratives [Book review]. *Psychology of Women Quarterly*, *41*(2), 287-288.

SELECTED PRESENTATIONS, POSTERS, AND INVITED TALKS **indicates sole presenter*

1. **Thomas, J.L.,*** Blanken, A., Huang, A., Maguen, S., Gibson, C.J., & Sumner, J.A. (2022). *Dimensions of posttraumatic stress, menopause symptoms, and sexual functioning in milife women veterans.* Research talk at International Society for Traumatic Stress Studies in symposium, "Trauma Exposure and Sexual Health Outcomes in Women" (chaired by **J. Thomas**); Atlanta, GA.

2. **Thomas, J.L.,*** Colich, N.L., McLaughlin, K.A., & Sumner, J.A. (2022). *Dimensions of early life adversity and sexual behavior among a U.S. population-representative sample of adolescents.* Research talk at American Psychosomatic Society in symposium, "Biological Embedding of Early Life Adversity: A Mechanism-Focused, Lifespan Approach" (chaired by J. Sumner, **J. Thomas**); Long Beach, CA.

3. **Thomas, J.L.,*** Nicoloro-SantaBarbara, J.M., Carroll, J.E., Minissian, M., Bairey Merz, N., Kilpatrick, S.J., & Accortt, E.E. (2021). *Inflammation mediates the association between spontaneous preterm birth and PTSD symptoms two years post-delivery*. Poster at Marcé of North America; virtual.

4. **Thomas, J.L.** (2021). *Sexual health, trauma, and posttraumatic stress disorder*. Invited guest presentation to Greater Los Angeles Veterans Affairs Trauma Psychology Seminar, 2020-2021.

SELECTED CLINICAL EXPERIENCES

UCLA Psychology Clinic (Individual, Couple, Group Psychotherapy; Assessments) Winter 2019 - present
Cedars-Sinai Medical Center, Obstetrics/Gynecology (Reproductive Psychology) Fall 2021 - Summer 2022
West Los Angeles Veterans Affairs (Trauma Recovery; Physical Medicine/Rehab**)** Fall 2021 - Sumer 2021

Introduction to Dissertation

Exposure to adversity and trauma is common yet unevenly patterned. Although approximately 70% of the world's population has experienced a trauma involving actual or threatened death, serious injury, or sexual violence (Benjet et al., 2016), women are at elevated risk of exposure to select traumatic events—including childhood maltreatment and sexual assault—compared to men (Blanco et al., 2018; Tolin & Foa, 2006). Moreover, many of the psychopathologies that often onset after trauma—including posttraumatic stress disorder (PTSD), depression, and anxiety—are more prevalent in women than in men (Kessler et al., 1994; Kessler et al., 1995; Salk et al., 2017). For example, PTSD—the quintessential trauma-related psychological condition characterized by re-experiencing of a traumatic event, avoidance, negative changes in thoughts and feelings, and hyperarousal—is twice as common in women as in men, with approximately 10-20% of trauma-exposed women meeting diagnostic criteria (Kessler et al., 1995). Further, PTSD has been found to be more chronic and associated with greater severity of impairment in women relative to men (Pratchett et al., 2010). Gender disparities in trauma exposure and its psychological consequences demonstrate the importance of traumatic stress research that centers and clarifies its impact on women and their health.

Trauma and its consequences shape health and well-being, marking these variables as critical constructs in the study of women's health. Indeed, extensive research has linked trauma and its sequelae with poor mental, physical, and sexual health outcomes across both civilian and military samples of trauma-exposed women. For example, trauma exposure frequently begets poor emotional health; diagnoses of PTSD, depression, anxiety and substance misuse disorders are all common following trauma (Goldmann & Galea, 2014; O'Donnell et al., 2008; Asselmann et al., 2018), and one large, population-representative study of adults in the United States found

that trauma exposure accounted for 24-63% of the risk of first-episode mood, anxiety, and substance-related psychopathologies (Walsh et al., 2017). The impact of trauma extends from the brain to the body, influencing physical health as well. Longitudinal studies have demonstrated that PTSD precedes and predicts the onset of a host of chronic physical health conditions in women, including indicators of cardiovascular disease (e.g., incident ischemic heart disease, stroke, myocardial infarction; Ebrahimi et al., 2020; Sumner et al., 2015), hypertension (Sumner et al., 2016), type 2 diabetes (Roberts et al., 2015), ovarian cancer (Roberts et al., 2015), and autoimmune disorders (Lee et al., 2016). Moreover, women with comorbid PTSD and depression—two common manifestations of posttraumatic psychopathology—are at elevated risk of premature mortality (Roberts et al., 2020). Further, trauma and related psychopathology are also associated with poor sexual health and dysfunction (Yehuda et al., 2015), particularly among survivors of sexual trauma (Schnurr et al., 2009; Kaltman et al., 2005; Kilpatrick et al., 1989). However, even non-sexual traumatic experiences—such as emotional abuse—are associated with adverse sexual health outcomes (LeBlanc et al., 2020).

Adopting a Lifespan Approach

Although trauma can occur at any time throughout the lifespan, there may be clinical utility in considering trauma exposure cumulatively when studying associations with women's health. In charting the periods during which traumatic experiences may be most prevalent and impactful for women (López-Castro et al., 2017), risk for trauma exposure is most elevated during adolescence and young adulthood—when girls are approximately 16 to 20 years of age. If left unaddressed, trauma and its effects may follow women throughout their lifetimes. For example, in one large community sample of older adults, individuals who reported that their currently most distressing trauma exposure happened during childhood—as opposed to after the

transition to adulthood—experienced more PTSD symptoms (Ogle et al., 2013). Indeed, posttraumatic stress is remarkably persistent. Half of all global cases of PTSD are chronic (Koenen et al., 2017), and while the duration of symptoms varies widely across trauma types (Morina et al., 2014), mean estimates of symptom duration approximate six years (Kessler et al., 2017). The persistence of posttraumatic stress is also evident in its treatment resistance. In an epidemiological study of adults in the U.S., PTSD—as anchored to the individual's most distressing lifetime trauma exposure—did not fully remit in more than one-third of individuals even after many years post-trauma and irrespective of treatment receipt (Kessler et al., 1995).

Trauma-related symptoms may also wax and wane across developmental periods (Cook & Simiola, 2018). Longitudinal PTSD research has demonstrated fluctuating courses of pathology following trauma exposure—in one 20-year-study of Israeli veterans, PTSD rates dropped three years following traumatic war experiences and rose again 17 years later (Solomin & Mikulincer, 2006). Both epidemiological and clinical research have cross-sectionally demonstrated that some older women—defined as aged 65 and older—with a history of assaultive trauma report clinically significant mood, anxiety, and trauma-related disorder symptomatology decades after exposure (Cook et al., 2011; Cook et al., 2013). These persistent symptoms may also represent a treatment gap: in a large sample of midlife and older women, one-third of those with a lifetime history of PTSD reported never receiving trauma-focused mental health treatment (Sampson et al., 2021). Adopting a lifespan approach in the study of trauma and women's health allows for capturing of diverse experiences and may aid in better understanding of how adverse experiences contribute to poor health.

Moreover, experiencing a traumatic event elevates likelihood of subsequent exposures (Benjet et al., 2016; Kessler et al., 2017), and recurrent trauma exposure carries additional risk

for negative health outcomes. For example, childhood often sets the stage for later-life experiences, and exposure to early life adversity—a wide range of negative circumstances including but not limited to traumatic life events—has been associated in a dose-response fashion with adverse physical and mental health conditions in adulthood (e.g., cancer, heart disease; Felitti et al., 1998; depressive disorders, Chapman et al., 2004). Cumulative childhood trauma exposure has also been linked with poor functional outcomes across life domains (e.g., health, wealth, social) during the transition to adulthood (Copeland et al., 2018). Additionally, adverse and traumatic experiences in early life can further sensitize individuals to the effects of later trauma exposure, thereby increasing risk of poor outcomes. For example, adversity-exposed individuals are at heightened risk for mood and anxiety disorders following stressful life events, with documented gender differences in the magnitude of this risk; compared to men, adversity-exposed women develop PTSD after fewer later-life traumas (McLaughlin et al., 2010). Considering the effects of cumulative trauma exposure at different points of the lifespan may reveal critical areas for intervention to improve women's health.

Importantly, the salience of certain health outcomes also varies across the lifespan, as women have distinct priorities and needs during different developmental windows. Indeed, the environmental contexts, stressors, and health-related challenges that women face shift over time, with discrete periods of the lifespan characterized by shared features. Adolescence, the perinatal period, and midlife represent three discrete periods of the lifespan wherein women experience a host of biological, psychological, and social changes that are highly relevant to overall health and well-being. Studying the role of trauma on health outcomes important to these notable periods may elucidate common themes that could be addressed in targeted interventions appropriate for dissemination during these life stages.

Adolescence

The marker of the transition between girlhood and womanhood, adolescence—often defined as ages 10-18 years—involves significant shifts for youths' health and development, including across physical, cognitive, and socioemotional domains. Socially, adolescents often vie for increased independence from their family systems in favor of more affiliation with peers (Smetana et al., 2006), and romantic and sexual relationships begin to take on greater importance (Collins et al., 2009). The hallmark of early adolescence is the onset of puberty, during which a series of rapid biological changes prepare the body for reproductive capacity. Pubertal development is often accompanied by the initiation of sexual activity (Fortenberry, 2013), which carries with it health concerns particularly relevant to adolescents. For example, youth ages 14-24 are over-represented among adverse sexual health outcomes, including unintended pregnancy and sexually transmitted infections (Centers for Disease Control and Prevention, 2022), and early-maturing girls endorse earlier sexual behavior (Copeland et al., 2010).

Lifetime experiences of trauma and related consequences may influence these processes among adolescents. For example, girls with (versus without) trauma histories report higher rates of risky sexual behavior during adolescence, including unprotected sex and multiple partnerships (Ryan et al., 2015). Some evidence also explicitly links early pubertal timing—often operationalized as early age at menarche, the time at which the first menstrual period occurs—with these sexual experiences among trauma-exposed youth (e.g., Ryan et al., 2015). This early pubertal timing—again, frequently operationalized as age of menarche—is also an independent risk factor for a wide range of sexual risk behaviors (e.g., election of numerous partners, as in Copeland et al., 2010; earlier sexual activity, as in Ellis, 2004). Greater attention to links between

trauma, puberty, and sexual health may reveal important considerations for screening and treatment during adolescence—the developmental window most implicated in sexual behavior.

The Perinatal Period

Moving across the lifespan, the perinatal period—the window inclusive of pregnancy and up to one year following delivery—represents another critical period for women's health. For women who become pregnant, the perinatal period can comprise a significant portion of the reproductive-age years (defined most often as ages 18-44). Pregnancy itself is an important developmental inflection point, during which the maternal immune system undergoes profound and progressive transformations central to the survival of mother and baby (Davis & Narayan, 2020). Numerous psychosocial changes, including increased financial stress and the emotional and cognitive demands of caring for a newborn, also arise during the postpartum period (Saxbe, Rossin-Slater, & Goldenberg, 2018). Moreover, the psychological and social role transition to motherhood—known as 'matresence' (Athan & Reel, 2015)—may be experienced by some women as overwhelming and difficult to manage, heightening stress and facilitating downstream effects on health. Further, the transition to parenthood is simultaneously linked with sizable shifts in physical and mental health—the effects of which can be long-lasting.

Of the many challenges that arise during this time, navigating couple relationships may be a particularly unique stressor. Partner relationship quality is important for both physical and mental health (Kiecolt-Glaser & Wilson, 2017; Robles et al., 2014), particularly during the perinatal period (Dunkel Schetter, 2011), as supportive relationships can serve protective effects in mitigating psychopathology during this time. For most couples, both partners' relationship functioning sharply declines postpartum (Doss et al., 2009; Mitnick, Heyman, & Smith Slep, 2009), and the mental health of both individuals within the dyad can exacerbate this association

(Doss & Rhoades, 2017). For example, higher levels of depressive and anxious symptomatology among couples during pregnancy predict greater declines in both partners' relationship satisfaction in the years following childbirth (Trillingsgaard et al., 2014). Trauma exposure and related psychopathology—most notably, PTSD—have been associated with relationship distress and dysfunction in civilian populations (Lambert et al., 2012; Taft et al., 2011), though less research has focused on these experiences among perinatal women and their partners.

To date, only three studies, one of which was methodologically weak (Ayers et al., 2007) and the other two of which were conducted in the same sample of 250 couples (Fredman et al., 2017; Marshall et al., 2019), have dyadically—in that both partners were assessed—investigated PTSD and relationship health in postpartum couples. The most rigorous of these studies employed a longitudinal design to prospectively predict intimate partner violence by both partners' PTSD symptoms (Marshall et al., 2019), highlighting the potential sequelae of unmanaged maternal *and* paternal PTSD symptoms during the postpartum period. However, the current evidence base in this area is based on data collected from approximately 300 couples from two predominately White and relatively high-income samples, and research in more diverse perinatal samples is needed. Moreover, no work has yet examined how couple concordance (versus discordance) in PTSD symptoms may intersect with relationship health metrics in couples during this transitory time; the aforementioned studies adopted an individual-level statistical approach, wherein the independent contributions of both partners' PTSD symptoms—controlling for the other partners' symptoms—were modeled. Understanding patterning in couples' posttraumatic stress—in the form of modeling both partners' PTSD symptoms in tandem as a couple-level variable and thus capturing couple concordance versus discordance—may reveal important intervention targets for maternal and paternal relationship functioning.

Midlife

Women in midlife—the period of time between younger and older adulthood, often considered as when women are between 45-65 years of age—also experience a host of biological, psychological, and social changes and stressors. Examples include the onset and progression of physical health conditions; balancing shifting family relationships (e.g., loss of partner due to separation or death, children moving out); and increased vulnerability to depression (Freeman et al., 2006; Thomas, Mitchell, & Woods, 2018). For midlife women, these developmental changes occur amid the additional context of the menopause transition, the biological shift from consistent menses to a final menstrual period. This transition is characterized by often distressing and disruptive physical symptoms, including sleeping difficulties, hot flashes and night sweats, and genitourinary concerns (e.g., urinary incontinence, vaginal dryness; Baker et al., 2018; Woods & Mitchell, 2005). Though normative for women to experience during and beyond the menopause transition, these symptoms are collectively associated with distress and impairment (Whiteley et al., 2013). Moreover, these symptoms—in conjunction with other accumulating aging-related risk factors (e.g., physical inactivity, weight changes)—influence women's health trajectories even beyond midlife; for example, sexual dysfunction—including experiencing pain during sex, decreased sexual desire, and low arousal—increases dramatically for postmenopausal women (Dennerstein, Alexander, & Kotz, 2003), as does risk for cardiovascular disease (El Khoudary et al., 2020).

A trauma history may interact with these and other important health markers among aging women, as midlife and older women who present for healthcare may have unresolved trauma contributing to, maintaining, or exacerbating their symptoms. For example, midlife and older women with abuse histories evince high rates of physical and emotional health problems,

including higher rates of sleep disorders and pain (Gibson et al., 2020), as well as suicidality (Talbot et al., 2004). The effects of trauma may also extend to trauma-exposed women's selection of—or decision to refrain from—discrete healthcare options during this time (Cook, 2021). As an example, older women with PTSD are less likely to be in trauma-focused mental health treatment than are younger women with the disorder (Sampson et al., 2021). While mechanisms explaining these associations have yet to be confirmed, these disparities highlight midlife as a potential window of opportunity during which to address trauma-related factors to improve women's health—both during the menopause transition and beyond.

Considering Subgroups

Furthermore, women are not a monolith, and understanding how diverse adverse and traumatic experiences impact women across sociodemographic groups has the potential to improve targeted screening and intervention. Certain subgroups of women—including low-income women and women of color—may be at disproportionate risk for trauma exposure and its pernicious effects due to structural embedding in oppressive socioecological contexts and social determinants of health. For example, elevated rates of PTSD are observed among low-income, minority, urban populations (Gillespie et al., 2009; Kessler et al., 1995), and racial and ethnic disparities persist even at the more granular level of PTSD's discrete symptom dimensions (Thomas, Carter et al., 2021). Other subgroups of women, such as servicewomen and women veterans, may also be at increased risk for trauma and its health-related sequelae. Relative to both civilian women and their veteran men counterparts, women veterans experience worse physical and mental health (Frayne et al., 2006; Lehavot et al., 2018) and demonstrate complex care needs (Creech et al., 2019), which may be a function of their unique roles and related stressors faced (e.g., Street et al., 2009). Indeed, experiences such as military sexual trauma are

common among this population (Wilson, 2018), and these experiences are associated, in turn, with greater clinical complexity and comorbidity of health conditions (Sumner et al., 2021). In studying associations between trauma exposure and health among the women most at-risk for traumatic stress, research can appreciate where the impact of trauma is the greatest—in the service of developing targeted interventions appropriate for specific populations.

Purpose of the Dissertation

In this three-study dissertation, I considered relationships between adversity and trauma exposure and related psychopathology and a constellation of health outcomes during three key periods of a woman's lifespan: adolescence, the reproductive-aged years, and during midlife. The first study adopted a dimensional approach in an examination of adverse experiences in early life and sexual behavior among a large, population-representative sample of adolescents in the United States. Second, in a large, community-based sample of low-income and racially and ethnically diverse couples during the postpartum period, I examined couple-level manifestations of posttraumatic stress symptoms (e.g., partners' concordance of PTSD symptoms, partners' discordance of PTSD symptoms) and associations with maternal and paternal relationship functioning—an important element of overall health during this transitory time. In the final study, I investigated associations between discrete PTSD symptom dimensions and markers of menopause-related health—including sexual functioning—in a sample of midlife women veterans. Taken together, these studies served to address the pernicious effects of trauma exposure and its sequelae on women's health across the lifespan.

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Study 1

Dimensions of early adversity and sexual behavior in a U.S. population-based adolescent sample

Abstract

Purpose: Early life adversity (ELA) is associated with sexual risk, but ELA dimensions—and potential mechanisms—have been less examined. I evaluated associations between threat and deprivation—two key ELA dimensions—and sexual behaviors in adolescents. Secondary analyses investigated age at menarche as a mechanism linking ELA with sexual outcomes in girls. I predicted associations between threat and sexual behaviors, with younger age at menarche as a pathway.

Methods: Data were from the National Comorbidity Survey, Adolescent Supplement. Adolescents and caregivers reported on youths' ELA experiences, which were categorized as threat- or deprivation-related. Adolescents reported if they had ever engaged in sex (*N*=9,937) and on specific sexual risk indicators, including age at first sex, number of past-year sexual partners, and condom use consistency ("always" versus "not always" used). Girls reported age at menarche.

Results: Threat (OR=1.76 [95% CI, 1.62–1.92]) and deprivation (OR=1.51 [95% CI, 1.24–1.83]) were each linked with engagement in sex, *p*s<.05. Threat-related experiences were associated with multiple sexual risk markers, even when accounting for deprivation: earlier age at first sex (*b*=-0.20 [95% CI, -0.27–-0.13]), greater number of partners (*b*=0.17 [95% CI, 0.10–0.25]), and inconsistent condom use (OR=0.72 [95% CI, 0.64–0.80]), *p*s <.001. Deprivation was not associated with sexual risk when adjusting for threat. I observed no significant indirect effects through age at menarche.

Conclusion: Although threat and deprivation were related to engagement in sexual activity, threat-related experiences were uniquely associated with sexual risk. Screening for threat-related ELA may identify adolescents at-risk for poor sexual health.

Introduction

Early life adversity (ELA)—including sexual, physical, and emotional abuse and neglect—impacts approximately one-half of all U.S. youth (McLaughlin et al., 2012) and is associated with deleterious mental and physical health, including sexual health, across the lifespan (Alley & Diamond, 2021; Belsky et al., 2015; McLaughlin et al., 2012; Norman et al., 2012; Felitti et al., 1998). Although initiation of sexual behavior is normative in adolescence (Tolman & McClelland, 2011), certain behaviors—particularly those carrying potential consequences of pregnancy or sexually transmitted infections (STIs)—may pose risk for adolescents' health. Despite comprising only a quarter of sexually active individuals, youth aged 15-24 years account for half of the annual cases of STIs (Centers for Disease Control and Prevention, 2022). Further, unintended adolescent pregnancy can carry substantial costs for mothers and offspring. Extensive evidence supports ELA as a predictor of sexual risk (Abajobir et al., 2017; Alley & Diamond, 2021), including STIs (Hillis et al., 2000; London et al., 2017), unintended pregnancy (Dietz et al., 1999; Hall et al., 2019; Hillis et al., 2004), greater number of sexual partners (Hillis et al., 2001; Hillis et al., 2004; London et al., 2017), and earlier age at first intercourse (Hillis et al., 2004; Ryan et al., 2015). Identifying and understanding links between ELA and sexual behavior in adolescents can inform timely intervention.

Recent conceptual models propose a dimensional understanding of ELA when elucidating pathways linking ELA with poor health, focusing on central, underlying dimensions that occur in adversities with shared elements (McLaughlin et al., 2021). Two key dimensions that pervade multiple ELA experiences include threat (harm to physical integrity; e.g., violence, sexual assault) and deprivation (absence of expected environmental inputs; e.g., food insecurity, neglect; McLaughlin & Sheridan, 2016), and research demonstrates that these dimensions have

distinct developmental consequences. In particular, early experiences of threat, but not deprivation, have been linked to accelerated development across multiple systems (Colich, Platt et al., 2020; Colich, Rosen et al., 2020; Sumner et al., 2019; Sun et al., 2020; Yuan, Yu, & Sun, 2021), including reproductive strategy indicators of biological aging like pubertal timing (Colich, Rosen et al., 2020; Yuan et al., 2021). Aligned with this perspective is Life History Theory, a developmental-evolutionary framework which posits that experiencing environments characterized by harshness (e.g., threat-related experiences) may accelerate development to maximize the potential for reproduction prior to mortality (Belsky, 2019; Ellis, 2004).

Although ELA has been associated with sexual risk, limited research has adopted a dimensional framework, instead focusing on discrete exposures (e.g., physical abuse) or cumulative risk. Though informative, these approaches respectively imply that the mechanisms linking ELA with sexual behavior are either wholly distinct or entirely shared across different adversities (for review, see McLaughlin et al., 2021). In contrast, a dimensional perspective advances that discrete ELA experiences characterized by common features may operate through shared mechanistic processes. Thus, considering similar ELA experiences in tandem allows for investigation of potential mechanisms, which may serve as intervention targets.

Advanced pubertal development—a marker of biological aging commonly studied in youth—may be one such mechanism. The timing and pace of puberty—metrics of which include pubertal stage relative to chronological age, as well as age of menarche in girls—is an established correlate of both threat-related adversity (Colich, Rosen et al., 2020; Yuan et al., 2021) and adolescent sexual behavior (Copeland et al., 2010; Ryan et al., 2015; Udry, 1979). Two largely independent literatures support this potential pathway, linking: 1) ELA—often operationalized as childhood sexual assault—with early menarche (Ellis, 2004; Noll, 2021); and

2) pubertal metrics with sexual risk (e.g., numerous partners, teen pregnancy; Copeland et al., 2010; Udry, 1979). Although some research has documented associations between ELA, pubertal timing, and sexual risk (Belsky et al., 2010; Ryan et al., 2015; Simpson et al., 2012), this work has focused largely on individual ELA types—despite evidence that adversities are highly co-occurring (McLaughlin et al., 2012) and growing appreciation for dimensional frameworks' capacity to identify and test mechanisms (Ellis et al., 2022; McLaughlin et al., 2021).

In this study, I examined associations between ELA dimensions of threat and deprivation with sexual behavior—including both engagement in sexual activity and indicators of sexual risk (e.g., condom use consistency)—in a large, population-representative sample of U.S. adolescents. Aligned with evolutionary thinking (Belsky, 2019), I predicted that threat-related ELA would be associated with indicators of both sexual activity and sexual risk, even when accounting for co-occurring deprivation. I also tested for moderation by participant sex, as ELA may differentially impact sexual behavior in boys and girls (James et al., 2012; Negriff, Schneidermann, & Trickett, 2015). Specifically, because these groups experience different behavioral consequences of sexual activity (e.g., carrying a pregnancy versus not), there may be important sex differences in discrete sexual behaviors following adversity (Del Giudice, 2009). Additionally, I evaluated age at menarche as a potential biological aging mechanism explaining these associations in girls. This study builds on prior work in this sample demonstrating that greater experiences of early life threat were associated with adverse psychological health in girls, in part through age of menarche (Colich, Platt et al., 2020). Similarly, I predicted that the threat-sexual behavior associations in girls may be partially explained by younger age at menarche.

Methods

Study Design

Data were from the National Comorbidity Survey—Adolescent Supplement (NCS-A), an epidemiological assessment of 10,123 U.S. adolescents. Conducted from 2001-2004, the NCS-A utilized a dual-frame design, recruiting youth aged 13-18 years from households and schools. Sample data were weighted based on the 2000 Census. Additional detail is provided in the Supplement and elsewhere (Kessler et al., 2009).

Caregivers provided written informed consent, and adolescents provided written assent. Adolescents completed interviews about early experiences and health, including sexual behaviors, and caregivers completed questionnaires about youths' developmental experiences and risk and protective factors. The analytic sample for this study comprised adolescents with valid data on ELA and the sexual behavior with the largest response (*engagement in sex,* n=9,937; see Table 1 for participant characteristics).

Measures

ELA. As in prior NCS-A work (Colich, Platt et al., 2020; McLaughlin et al., 2012), ELA experiences were captured via multi-informant, multi-method assessment. Adolescents and caregivers reported on lifetime exposure to nine ELAs, categorized as falling primarily along one of two dimensions: threat-related (physical abuse, emotional abuse, domestic violence, sexual assault, violent victimization, witnessing violence) or deprivation-related (neglect, food insecurity, parental education attainment less than high school degree). Each adversity was coded as present if endorsed by the adolescent and/or caregiver; adversities were summed to create total composite scores for both threat and deprivation.

Sexual behavior. Adolescents disclosed if they ever engaged in sexual intercourse (n=9,937). Those endorsing sexual experience then reported on three sexual risk indicators. First, adolescents indicated their age at first intercourse (n=2,151). Consistent with prior NCS-A

research (Vafai, Thoma, & Steinberg, 2020), I excluded girls who reported this age as ≤11 years due to greater likelihood of this activity being non-consensual. Second, adolescents reported the number of past-year sexual partners (*n*=2,217). Third, adolescents reported how frequently they or their partner(s) wore condoms during sex during the past year (*n*=2,016). I dichotomized responses into consistent ("always") versus inconsistent ("not always"), as in other NCS-A research (Miller et al., 2018).

Age at menarche. Girls reported the age at which they experienced their first period (*n*=4,937). There was no equivalent measure of pubertal timing available for boys.

Covariates. Analyses adjusted for age, race and ethnicity (White, Black, Latinx, Other), and family income (specifically, household income-to-poverty ratio). Participant sex was included as a covariate in models using the overall sample and as a potential moderator of ELA-sexual behavior associations.

Statistical Analysis

After employing descriptive statistics characterize the sample, I completed a series of survey-weighted regression analyses. First, I examined associations between threat and deprivation with the four sexual behaviors, with separate models for each dimension and outcome. Logistic regression was used for binary outcomes (engagement in sex, condom use consistency), and linear regression was used for continuous outcomes (age at first sex, number of past-year partners). Given moderate co-occurrence of threat- and deprivation-related experiences (r=.20, p<.001), I estimated models that included both dimensions to model unique associations of one dimension while statistically controlling for the other. Next, I tested for interactions between participant sex and ELA in the ELA-sexual behavior associations. Finally, in girls only, I examined age at menarche as a candidate pathway linking ELA with sexual behavior. Because

prior work in this sample established a threat-specific association with age at menarche (Colich, Platt et al., 2020), I did not re-iterate those findings. Instead, I focused on independent associations between age at menarche and sexual behaviors and tested for indirect effects in instances where an ELA dimension was significantly associated with a discrete sexual behavior.

I conducted several sensitivity analyses. First, given a robust literature linking experiences of childhood sexual assault with risky sexual behavior (Noll, 2021), I examined whether any threat-specific findings were driven by childhood sexual assault by re-calculating the threat composite without this indicator. Second, the threat composite included more indicators than did the deprivation composite, potentially biasing results due to wider variability of one dimension. I created standardized scores of both the threat and deprivation composites to evaluate this possibility. Third, in subanalyses involving menarche, I considered body mass index (BMI) as an additional covariate. Given sizeable missingness in BMI data (n=251), I elected to present results with and without BMI to maximize sample size while also testing robustness of findings. Fourth, given the wide range of reported age at menarche and potential medical etiologies of early onset (Rosenfield, Lipton, & Drum, 2009), I removed girls reporting menarche onset at <10 years and replicated tests involving menarche. Fifth, in order to address temporal issues regarding ELA and pubertal timing, I excluded post-menarche ELA experiences where data on ELA timing were available. Additional detail regarding the methods and analytic approach is available in the Supplement.

Results

Descriptive statistics

As shown in Table 1, adolescents had a mean age of 15.2 years. Over one-half were White, with the remaining of minoritized racial and ethnic status. Many (45.2%) endorsed at

least one threat- or deprivation-related experience; the most commonly endorsed ELA was low parental education. Nearly one-quarter of the sample reported a history of sexual activity. Among those with sexual experience, adolescents were 14 years of age, on average, at their first sexual intercourse. The average number of past-year partners was 1.62, and most reported consistent condom use. Among girls, the average age at menarche was 12.1 years.

Associations between ELA dimensions and sexual behavior

Experiencing a greater number of threat-related adversities was associated with all sexual behaviors (Table 2). Specifically, higher threat composite scores were linked with elevated odds of having ever engaged in sex (OR=1.76 [95% CI, 1.62–1.92]) and inconsistent condom use (OR=0.71 [95% CI, 0.64–0.79]), in addition to earlier age at first sex (b=-0.21 [95% CI, -0.28–-0.14]) and greater number of past-year partners (b=0.17 [95% CI, 0.10–0.25]). Effect sizes for threat-related ELA were similar and remained significant when adjusting for deprivation (Table 2).

Although deprivation-related ELA was associated with greater likelihood of having ever engaged in sex and earlier age at first sex, only the association with engagement in sex remained significant when adjusting for threat (OR=1.26 [95% CI, 1.10–1.56]; Table 2).

Moderation by participant sex

I then investigated potential moderation by participant sex. As seen in Table 3, there was a significant Sex x Threat-related ELA interaction in predicting engagement in sex (b=0.20, p=0.03) and number of past-year partners (b=-0.12, p=0.04), even when controlling for deprivation. Table 4 presents sex-stratified results for these threat-specific associations. Although cumulative threat significantly predicted greater likelihood of engagement in sex and more past-year partners in both subgroups, the association of threat with engagement in sex was stronger

for girls than for boys, whereas the association of threat with number of recent partners was stronger for boys than girls. In contrast, only one significant Sex x Deprivation-related ELA interaction emerged (Table 3), which did not reveal meaningful differences in sexual behaviors in boys versus girls (Supplementary Table 2).

Associations between ELA, age at menarche, and sexual behavior in girls

As seen in Table 5, earlier age at menarche was associated with elevated odds of engagement in sex (OR=0.86 [95% CI, 0.78–0.95]) and with earlier age at first sex (b=0.12 [95% CI, 0.05–0.18]). No significant associations were observed with number of past-year partners or condom use consistency. In tests of indirect effects linking ELA dimensions, age at menarche, and sexual behavior, no significant indirect effects emerged (Table 5).

Sensitivity analyses

Results demonstrating associations between the dimensions and sexual behaviors did not change when I removed experiences of sexual assault from the threat composite (Supplementary Table 3), nor when I used standardized scores for both composites (Supplementary Table 4). Findings from tests of indirect effects linking ELA and sexual behavior through younger age at menarche were also largely unchanged when I included the BMI covariate (Supplementary Table 5), as well as when limiting analyses to girls with menarche onset $\geq$10 years (Supplementary Table 6) and when excluding known instances of post-menarche ELA (Supplementary Table 7).

Discussion

I present novel evidence demonstrating dimension-specific associations between ELA and sexual behavior in adolescents. Specifically, I found that although ELA experiences characterized by threat and deprivation were both associated with engagement in sexual behavior, a greater number of threat-related experiences was uniquely linked with diverse

indicators of sexual risk, including earlier age at first sex, greater number of past-year partners, and inconsistent condom use. These specific behaviors are notable in that they contribute to heightened risk for unintended pregnancy and STI contraction and are associated with suboptimal adolescent health (Centers for Disease Control and Prevention, 2022). Understanding variation in early experiences and associated risk for poor sexual health may inform interventions in adolescence.

These findings complement and extend evidence linking ELA and adverse sexual health. Epidemiological work has demonstrated associations between cumulative measures of ELA and various sexual risk markers (Dietz et al., 1999; Hall et al., 2019; Hillis et al., 2001; Hillis et al., 2000; London et al., 2017). Other research has linked select ELA experiences—frequently, childhood sexual assault—with risky sexual behavior in youth (Ryan et al., 2015), including a prior NCS-A study examining physical abuse and condom use (Miller et al., 2018). Another study in a nationally representative sample found that childhood sexual and physical abuse—but not neglect—were associated with earlier age at first sex and greater number of partners—findings aligned with my own demonstrating differential associations for threat and deprivation experiences (Ryan et al., 2015). Indeed, the divergence in findings for threat- vs. deprivation-related ELA was consistent across sexual risk indicators. Whereas threat experiences were associated with younger age at first sex, a greater number of past-year partners, and inconsistent condom use even when adjusting for deprivation, associations of deprivation-related ELA with earlier age at first sex were attenuated and no longer significant when adjusting for threat. This pattern of results mirrors findings in the dimensional ELA literature (Sumner et al., 2019) and suggests specificity of associations between threat and sexual risk. Notably, threat-specific findings remained even when removing sexual assault—a well-established early life predictor of

sexual sequelae (Noll, 2021)—from the threat composite. This suggests there is something about the experience of threat generally, rather than particular to sexual assault per se, that confers risk for adverse sexual behavior, thereby demonstrating the value of dimensional approaches.

To my knowledge, only two other studies have examined ELA dimensions and sexual behavior (Belsky et al., 2012; Simpson et al., 2012). Both employed a dimensional model capturing experiences of early life unpredictability—indexed by variation in parental employment, residences, and cohabitation patterns—and harshness—indexed by low socioeconomic status—in contrast to this model of threat and deprivation. Though this research linked unpredictability with greater number of sexual partners, findings regarding the role of harshness were mixed. Although the authors acknowledge that their operationalizations represent only one way of capturing ELA, these results suggest that when it comes to sexual behavior, threat and deprivation may not be the only relevant dimensions of environmental experience. Indeed, recent proposals emphasize incorporating unpredictability into the threat-deprivation framework (Ellis et al., 2022), as certain ELA experiences may contain elements of multiple dimensions (e.g., experience is both threatening and unpredictable). Future research should incorporate indicators of unpredictability in tandem with threat and deprivation and examine how interactions across dimensions influence outcomes.

Despite evidence that ELA may differentially impact sexual behavior in boys and girls (James et al., 2012; Negriff et al., 2015), I found largely similar patterns of associations in this population-representative sample. Nevertheless, some small differences emerged. Similar to prior work (Negriff et al., 2015), threat-exposed boys reported more past-year partners than similarly-exposed girls, whereas girls with greater threat-related ELA were at slightly elevated odds of engagement in sex compared to boys. Evolutionarily, reproductive success involves

distinct life history strategies across the sexes, which may translate into different sexual behaviors based on associated sex-specific trade-offs between mating and reproduction (Del Giudice, 2009). However, given socialization processes that dictate differential acceptability of sexual behavior for men and women, these differences could also reflect social norms (Conley et al., 2011).

Contrary to hypotheses, biological aging—defined by age at menarche—did not emerge as a pathway linking threat-related ELA and sexual behaviors. Prior research rooted in Life History Theory has supported a threat-specific link with accelerated pubertal timing as indexed by age at menarche (Colich, Rosen et al., 2020), including in previous work in this sample (Colich, Platt et al., 2020) and a population-representative sample of Chinese women (Yuan et al., 2021). Further, the prior study in this sample demonstrated that younger age at menarche explained associations between threat-related ELA and psychopathology (Colich, Platt et al., 2020), highlighting pubertal timing as threat-specific sequelae. A logical extension of this work is to examine associations between threat, biological aging, and sexual behaviors, as reproductively-oriented life history strategies. In this study, I found that younger age at menarche was associated with elevated odds of engagement in sex and with earlier age at first sex. However, I observed no significant indirect effects of age at menarche on associations between threat-related experiences and sexual behaviors, even when adjusting for BMI, an established confounder of pubertal timing (Rosenfield et al., 2009). In contrast, research in another nationally representative sample established that younger age at menarche partially explained associations between childhood sexual abuse and age at first sex (Ryan et al., 2015). A smaller study found that maternal harshness predicted earlier age at menarche, which predicted greater sexual risk-taking (Belsky et al., 2010). Although I did not observe similar mechanistic patterns

here, I propose equifinality—or rather, that while both ELA and menarche appear to be important for certain sexual behaviors, these constructs may not operate through one another as hypothesized. Additionally, several methodological issues—including lack of data on duration of ELA experiences—may preclude this study's ability to rule out pubertal timing as a pathway.

While these results cannot speak to why threatening experiences are uniquely associated with sexual risk, I offer hypotheses. As proposed by Life History Theory (Belsky, 2019; Ellis et al., 2022), certain behaviors lead to greater reproductive success in adverse environments. These behaviors may subsequently be selected for over generations and thereby be more well-represented in specific contexts. For example, threatening environments (e.g., interpersonal violence) may select for behaviors that increase the likelihood of pregnancy (e.g., multiple partners) and thus maximize potential reproduction prior to harm or death. In contrast, depriving environments (e.g., food-insecure) constrain resources necessary for successful development and reproduction. In these contexts, the same sexual behaviors may not be as advantageous. Importantly, this theory asserts that natural selection implicitly shapes reproductively-oriented behaviors over time. In other words, the idea is not that adversity-exposed individuals consciously choose behaviors that are more likely to pass along their genes. Rather, specific behaviors are selected for and thus become more likely to be represented in future generations in certain environments. Toward this way of thinking, threat and deprivation impose distinct pressures and constraints that might lead to divergent associations with sexual behaviors—theoretical proposals consistent with this study's findings. Future research should continue to explore these divergences, as well as test other potential mechanisms—including other, non-pubertal markers of biological aging—linking threat-related ELA with sexual risk.

In this paper, I extend the literature on dimensional distinctions of threat- and deprivation-related ELA to a domain with particular importance to providers who work with adolescents: sexual behavior. Nationally, there is growing interest in integrating ELA screening into healthcare settings to facilitate early detection and intervention. Indeed, one pediatric screener—the PEARLS (Thakur et al., 2020), based largely on the Adverse Childhood Experiences inventory (Felitti et al., 1998)—recently qualified for Medi-Cal reimbursement. Though this tool and others may cast a broad net to identify individuals most at-risk for negative ELA-related outcomes, these findings suggest that targeted screening of ELA dimensions may hold clinical promise and tailor identification efforts. In particular, screening for threat-related ELA during routine healthcare visits may help identify youth at-risk for adverse sexual health. I encourage development of more focused ELA screeners (e.g., those that assess threat-related experiences) to assess potential sexual risk in pediatric healthcare settings. While screening alone is not enough to offset risk, understanding nuances in how different types of adverse experiences confer sexual risk may guide appropriate referrals and interventions, such as sexual health education or counseling for threat-exposed youth.

This study has limitations. As with most work on ELA and biological aging, analyses were cross-sectional, with ELA, menarche, and sexual behaviors retrospectively reported. Further, due to differential responses for different sexual behaviors, sample sizes varied across outcomes, and all were self-reported by youth. Moreover, I was unable to investigate biological aging in boys due to unavailable data. Finally, though examination of these associations in a nationally representative sample allows for generalization of findings, it may result in more conservative estimates compared to more circumscribed samples, such as among individuals selected for adversity exposure or sexual risk. I encourage additional research to test these

questions in such samples. Nevertheless, this study has several strengths, including using a multi-informant, multi-method approach to assessing ELA dimensions; examining multiple indicators of sexual behavior in a population-representative sample of adolescents; and conducting several sensitivity analyses to determine the robustness of these threat-specific findings.

Conclusion

Considering ELA dimensions revealed nuanced associations with sexual behaviors in adolescents. Though both threat- and deprivation-related ELA were associated with engagement in sex, threat-related experiences were uniquely associated with earlier age at first sex, greater number of past-year partners, and inconsistent condom use in both boys and girls. Early pubertal timing was independently associated with select sexual behaviors, but did not emerge as a pathway linking threat with sexual outcomes, suggesting that additional mechanisms may be operating. Early threat-related experiences may indicate that youth are vulnerable to risky sexual behavior during adolescence.

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Table 1. Participant Characteristics (*N*=9,937)

	M (*SD*)	Range	% (*n*)
Demographics			
Age, years	15.2 (1.50)	13-18	
Sex, %			
Girls			50.9 (5,055)
Boys			49.1 (4,882)
Race/ethnicity, %			
White			56.2 (5,588)
Black			18.8 (1,872)
Latino			18.8 (1,870)
Other			6.1 (607)
Household income-to-poverty ratio	6.02 (7.64)	0-142.06	
Parent education, %			
<HS graduate			16.4 (1,631)
HS graduate			30.3 (3,015)
Some college			19.8 (1,965)
College graduate or advanced			33.5 (3,326)
Early Life Adversity Experiences			
Threat-related experiences composite	0.59 (0.98)	0-6	
Physical abuse, %			3.9 (390)
Domestic violence, %			9.4 (938)
Sexual assault, %			5.3 (526)
Violet victimization, %			8.9 (885)
Witnessing violence, %			12.8 (1,268)
Emotional abuse, %			6.3 (625)
Deprivation-related experiences composite	0.30 (0.52)	0-3	
Low parent education (<HS graduate), %			16.4 (1,631)
Food insecurity, %			12.8 (1,275)
Neglect, %			0.7 (73)
Age at Menarche			
Age at menarche, years	12.1 (1.26)	6-17	
Sexual Behaviors			
Ever engaged in sex, %			22.7 (2259)
Age at first sex, years	14.80 (1.35)	12-18	
Number of past-year sexual partners	1.63 (1.24)	0-5	
Condom use consistency, %			
Consistent (“Always”)			64.1 (1,292)
Inconsistent (“Not always”)			35.9 (724)

Table 2. Associations Between ELA Dimensions and Sexual Behavior in Overall Sample

	Ever engaged in sex *n*=9,937		Age at first sex *n*=2,151		Number of past-year partners *n*=2,217		Condom use consistency *n*=2,016	
	OR (95% CI)	*p*	*b* (95% CI)	*p*	*b* (95% CI)	*p*	OR (95% CI)	*p*
Threat-related experiences								
Model 1[a]	1.76 (1.62, 1.92)	**<.001**	-0.21 (-0.28, -0.14)	**<.001**	0.17 (0.10, 0.25)	**<.001**	0.71 (0.64, 0.79)	**<.001**
Model 2[b]	1.73 (1.58, 1.89)	**<.001**	-0.20 (-0.27, -0.13)	**<.001**	0.17 (0.10, 0.25)	**<.001**	0.72 (0.64, 0.80)	**<.001**
Deprivation-related experiences								
Model 1[a]	1.51 (1.24, 1.83)	**<.001**	-0.23 (-0.37, -0.09)	**.003**	0.09 (-0.08, 0.25)	.31	0.79 (0.63, 1.00)	.06
Model 2[c]	1.26 (1.10, 1.56)	**.04**	-0.14 (-0.28, 0.01)	.07	0.00 (-0.17, 0.17)	.99	0.92 (0.71, 1.20)	.56

Note: Sample sizes varied given differential responses across items.

[a]Model adjusted for sex, age, race and ethnicity, and family income (household income-to-poverty ratio).

[b]Model 1 further adjusted for the number of deprivation-related experiences.

[c]Model 1 further adjusted for the number of threat-related experiences.

Table 3. Parameter Estimates for Participant Sex X ELA Dimension Interactions in Predicting Sexual Behaviors in Overall Sample

	Ever engaged in sex *n*=9,937		Age at first sex *n*=2,151		Number of past-year partners *n*=2,217		Condom use consistency *n*=2,016	
	b (95% CI)	*p*	*b* (95% CI)	*p*	*b* (95% CI)	*p*	*b* (95% CI)	*p*
Participant sex x threat-related experiences								
Model 1[a]	0.20 (0.03, 0.37)	**.03**	0.09 (-0.01, 0.20)	0.09	-0.12 (-0.24, -0.01)	**.04**	0.01 (-0.24, 0.27)	.92
Model 2[b]	0.20 (0.03, 0.37)	**.03**	0.10 (-0.00, 0.21)	0.07	-0.12 (-0.24, -0.01)	**.04**	0.02 (-0.24, 0.27)	.90
Participant sex x deprivation-related experiences								
Model 1[a]	-0.05 (-0.32, 0.22)	0.71	-0.23 (-0.39, 0.14)	0.36	-0.27 (-0.51, -0.03)	**.04**	-0.32 (-0.79, 0.15)	.19
Model 2[c]	-0.13 (-0.41, 0.16)	0.39	-0.03 (-0.31, 0.25)	0.84	-0.36 (-0.60, -0.11)	**.007**	-0.18 (-0.64, 0.29)	.46

Note: Sample sizes varied given differential responses across items.

[a]Model adjusted for sex, age, race and ethnicity, and family income (household income-to-poverty ratio).

[b]Model 1 further adjusted for the number of deprivation-related experiences.

[c]Model 1 further adjusted for the number of threat-related experiences.

Table 4. Sex-stratified Associations Between Threat-related ELA Experiences and Select Sexual Behaviors

	Boys		**Girls**	
Ever engaged in sex	*n*=4,882		*n*=5,055	
	OR (95% CI)	*p*	OR (95% CI)	*p*
Threat-related experiences				
Model 1[a]	1.53 (1.37, 1.71)	**<.001**	1.97 (1.73, 2.26)	**<.001**
Model 2[b]	1.29 (0.99, 1.68)	**<.001**	1.94 (1.69, 2.23)	**<.001**
Number of past-year partners	*n*=1,162		*n*=1,055	
	b (95% CI)	*p*	*b* (95% CI)	*p*
Threat-related experiences				
Model 1[a]	0.24 (0.12, 0.35)	**<.001**	0.14 (0.07, 0.20)	**<.001**
Model 2[b]	0.23 (0.11, 0.35)	**<.001**	0.15 (0.09, 0.21)	**<.001**

Note: Sample sizes varied given differential responses across items.

[a]Model adjusted for age, race and ethnicity, and family income (household income-to-poverty ratio).

[b]Model 1 further adjusted for the number of deprivation-related experiences.

Table 5. Associations Between ELA Experiences, Age at Menarche, and Sexual Behavior in Adolescent Girls

	Ever engaged in sex *n*=4,819		Age at first sex *n*=1,025		Number of past-year partners *n*=1,041		Condom use consistency *n*=964	
	OR (95% CI)	*p*	*b* (95% CI)	*p*	*b* (95% CI)	*p*	OR (95% CI)	*p*
Associations between pubertal timing and sexual behavior								
Age at menarche	0.86 (0.78, 0.95)	**.004**	0.12 (0.05, 0.18)	**.002**	0.00 (-0.06, 0.06)	>.99	0.99 (0.86, 1.13)	.83
ELA, pubertal timing, and sexual behavior model								
Threat-related experiences								
Indirect effect[a]	1.01 (1.00, 1.03)	.10	0.00 (-0.02, 0.01)	.48	0.00 (0.00, 0.00)	.87	1.00 (0.99, 1.01)	.82
Direct effect[b]	1.95 (1.72, 2.21)	**<.001**	-0.18 (-0.26, -0.09)	**<.001**	0.14 (0.07, 0.21)	**<.001**	0.72 (0.60, 0.82)	**<.001**
Total effect[c]	1.97 (1.74, 2.24)	**<.001**	-0.18 (-0.27, -0.09)	**<.001**	0.14 (0.07, 0.20)	**<.001**	0.73 (0.60, 0.83)	**<.001**
Deprivation-related experiences								
Indirect effect[a]	1.01 (1.00, 1.00)	.28						
Direct effect[b]	1.62 (1.23, 1.99)	**.001**						
Total effect[c]	1.63 (1.28, 2.00)	**.001**						

Note: All models adjusted for age, race and ethnicity, and family income (household income-to-poverty ratio). Sample sizes varied given differential responses across items.

[a]Effect of ELA dimension on sexual behavior through age of menarche.

[b]Effect of ELA dimenson on sexual behavior when accounting for age of menarche.

[c]Effect of ELA dimension on sexual behavior.

Supplement

Study Design

The National Comorbidity Survey—Adolescent Supplement (NCS-A) was designed as a population-representative assessment of the prevalence and correlates of mental health disorders among adolescents (51.1% female) in the United States.[1] Youth were recruited both from households that participated in a national survey of adult psychopathology (the National Comorbidity Survey—Replication [NCS-R]; *n*=879 adolescents; 86.8% response rate, conditional on adult's NCS-R participation) and from schools in the NCS-R's sample areas (*n*=9,244 adolescents; 82.6% response rate, conditional on school participation).[2] All NCS-A study protocol and procedures were approved by the Human Subjects Committees of both Harvard University and the University of Michigan. Cases were weighted to account for within-household likelihood of selection for youth recruited from households, as well as for residual discrepancies between the sample and the population on sociodemographic and geographic variables.[2] More information on NCS-A design and weighting procedures is described elsewhere.[1-2]

For this study, I excluded 211 of the 10,123 adolescents from NCS-A due to missing data on variables of interest (see Measures below)—with a resultant analytic sample of 9,937. Participants who were included versus excluded from the analytic sample were younger, on average, as well as reported fewer ELA experiences. A greater proportion of girls and individuals of minoritized racial and ethnic identities were excluded (see Supplementary Table 1).

Measures

ELA. Adolescents' exposure to nine discrete adversity types was ascertained through both adolescent interviews and caregiver questionnaires. Physical and emotional abuse, as well as domestic violence, were assessed via an adapted version of the Conflict Tactics Scale.[3] Experiences of sexual assault—including instances of attempted and completed rape—were captured by questions from the Composite International Diagnostic Interview.[4] Violent victimization and witnessing violence were each indicated by a single item in the adolescent interview. Neglect experiences were indexed from an adapted child welfare investigative tool that inquired about inadequate supervision, developmentally-unsuitable chores, and absence of appropriate food, clothing, and medical care.[5] Experiences of food insecurity over the past year were abstracted from an adapted version of the Household Food Security Scale,[6] as done in other NCS-A studies.[7] Finally, parental education attainment was coded from demographic information provided by the caregiver. I classified "low" educational attainment as earning less than a high school degree; earning a GED was coded as equivalent to a high school education. Parental education was included as a deprivation indicator given evidence that youth from families of low socioeconomic backgrounds—defined as low parental education and/or low household income—experience reduced cognitive stimulation relative to their higher-SES peers,[8,9] and cognitive stimulation was not measured directly in the NCS-A. Additional information on how discrete adversities were operationalized is available in prior NCS-A publications.[10,11]

Sexual behavior. Individuals who reported on history of sexual experience (yes/no) constituted the analytic sample (*N*=9,937). Within this sample, I identified individuals with valid data on

each of the sexual risk behaviors (e.g., age at first sex, number of past-year partners, condom use consistency). Correlations across these indicators were small (*r*s=.06 to -.21), suggesting specificity of behaviors, and sample sizes fluctuated due to differential responses across items. I ran separate analyses for each discrete outcome to maximize available data. Individuals with missing data or who indicated "does not apply" for a particular sexual behavior were excluded. Due to potentially implausible and extreme outliers on the past-year partners variable (e.g., 90 sexual partners), I winsorized the top 1% of the distribution; final values ranged from 0-5.

Covariates. Body mass index (BMI) was indexed by self-reported height and weight. As in prior research, including previous work in this sample,[11] I standardized the variable and modeled it continuously in analyses.[12,13]

Statistical Analysis

Analyses were completed in RStudio (Version 1.3.1093) and Mplus (Version 8.3). I conducted a series of survey-weighted regression models, accounting for the complex survey design, to test associations between ELA dimensions and discrete sexual behaviors.[14] I then tested for potential moderation by participant sex. For significant interactions, sex-stratified associations are presented to aid in interpretation. Finally, I investigated indirect effects of ELA dimensions on continuous outcomes (e.g., age at first sex) through age at menarche using the "lavaan survey" package in R.[15] Because "lavaan survey" cannot model binary outcomes in tests of indirect effects at this time, I used the MODEL INDIRECT statement in Mplus for analyses involving binary outcomes (e.g., engagement in sex), while also accounting for the complex survey design.[16]

Data on the timing of discrete adversities was available for five out of the six threat-related ELA experiences (sexual assault, physical abuse, witnessing domestic violence, witnessing or direct participant in violent victimization) but not for any of the deprivation-related experiences. Using available information, I re-calculated a threat composite that excluded ELA experiences that occurred following menarche. As in prior work,[11] I used this variable in a sensitivity analysis to address concerns regarding the timing of ELA and menarche.

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Supplementary Table 1. Participant Characteristics for Those Included Versus Excluded in the Analytic Sample

	Included *n*=9,937	Excluded *n*=211		
	M (*SD*) or % (n)	*M* (*SD*) or % (n)	*t* or $\varkappa 2$	*p*
Demographics				
Age, years	15.16 (1.50)	16.18 (1.49)	9.75	<.001
Sex				
Girls	50.9 (5,055)	60.7 (128)	7.93	.005
Boys	49.1 (4882)	39.3 (83)		
Race/ethnicity, %			78.182	<.001
White	56.2 (5,588)	28.4 (60)		
Black	18.8 (1,872)	39.3 (83)		
Latino	18.8 (1,870)	24.6 (52)		
Other	6.1 (607)	7.6 (16)		
Household income to poverty ratio	6.02 (7.64)	5.18 (5.60)	-1.58	.11
Early Life Adversity Experiences				
Threat composite	0.59 (0.98)	1.26 (1.19)	8.14	<.001
Physical abuse	3.9 (390)	6.2 (13)	2.71	.10
Domestic violence	9.4 (938)	17.5 (37)	15.594	<.001
Sexual assault	5.3 (526)	15.2 (32)	38.755	<.001
Violet victimization	8.9 (885)	17.1 (36)	16.653	<.001
Witnessing violence	12.8 (1,268)	20.9 (44)	12.020	<.001
Emotional abuse	6.3 (625)	12.3 (26)	12.525	<.001
Deprivation composite	0.30 (0.52)	0.48 (0.58)	4.44	<.001
Low parent education (<HS graduate)	16.4 (1,631)	30.3 (64)	28.768	<.001
Food insecurity	12.8 (1,275)	16.1 (34)	1.982	.16
Neglect	0.7 (73)	1.4 (3)	1.313	.25

Note: Participants were excluded if they did not have valid response data on engagement in sexual behavior.

Supplementary Table 2. Sex-stratified Associations Between Deprivation-Related ELA Experiences and Select Sexual Behaviors

	Boys		**Girls**	
Number of past-year partners	*n*=1,162		*n*=1,055	
	b (95% CI)	*p*	*b* (95% CI)	*p*
Deprivation-related experiences				
Model 1[a]	0.19 (-0.03, 0.40)	0.09	-0.01 (-0.21, 0.19)	0.92
Model 2[b]	0.12 (-0.10, 0.35)	0.29	-0.12 (-0.33, 0.09)	0.27

[a]Model adjusted for age, race and ethnicity, and family income (household income-to-poverty ratio).
[b]Model 1 further adjusted for the number of threat-related experiences.

Supplementary Table 3. Associations Between ELA Dimensions, Using Threat Composite Minus Sexual Assault, and Sexual Behavior in Overall Sample

	Ever sex *n*=9,937		Age at first sex *n*=2,151		Number of past-year partners *n*=2,217		Condom use consistency *n*=2,016	
	OR (95% CI)	*p*	*b* (95% CI)	*p*	*b* (95% CI)	*p*	OR (95% CI)	*p*
Threat-related experiences minus sexual assault								
Model 1[a]	1.85 (1.68, 2.03)	**<.001**	-0.21 (-0.27, -0.14)	**<.001**	0.19 (0.11, 0.26)	**<.001**	0.71 (0.64, 0.78)	**<.001**
Model 2[b]	1.81 (1.65, 2.00)	**<.001**	-0.19 (-0.27, -0.12)	**<.001**	0.19 (0.11, 0.26)	**<.001**	0.71 (0.64, 0.79)	**<.001**

Note: Sample sizes varied given differential responses across items.

[a]Model adjusted for sex, age, race and ethnicity, and family income (household income-to-poverty ratio).

[b]Model 1 further adjusted for deprivation-related experiences.

Supplementary Table 4. Associations Between ELA Dimensions, Using Standardized Scores, and Sexual Behavior in Overall Sample

	Ever sex *n*=9,937		Age at first sex *n*=2,151		Number of past-year partners *n*=2,217		Condom use consistency *n*=2,016	
	OR (95% CI)	*p*	*b* (95% CI)	*p*	*b* (95% CI)	*p*	OR (95% CI)	*p*
Threat-related experiences								
Model 1[a]	3.10 (2.61, 3.69)	**<.001**	-0.42 (-0.56, -0.28)	**<.001**	0.35 (0.20, 0.49)	**<.001**	0.51 (0.41, 0.62)	**<.001**
Model 2[b]	3.00 (2.50, 3.59)	**<.001**	-0.40 (-0.54, -0.25)	**<.001**	0.35 (0.20, 0.50)	**<.001**	0.51 (0.41, 0.64)	**<.001**
Deprivation-related experiences								
Model 1[a]	1.51 (1.24, 1.83)	**<.001**	-0.23 (-0.37, -0.09)	**.003**	0.09 (-0.08, 0.25)	.31	0.79 (0.63, 1.00)	.06
Model 2[c]	1.26 (1.10, 1.56)	**.04**	-0.14 (-0.28, 0.01)	.07	0.00 (-0.17, 0.17)	.99	0.92 (0.71, 1.20)	.56

Note: Sample sizes varied given differential responses across items.

[a]Model adjusted for sex, age, race and ethnicity, and family income (household income-to-poverty ratio).

[b]Model 1 further adjusted for deprivation-related experiences.

[c]Model 1 further adjusted for threat-related experiences.

Supplementary Table 5. Associations Between ELA Experiences, Menarche, and Sexual Behavior in Adolescent Girls, Adjusting for Body Mass Index

	Ever engaged in sex *n*=4,595		Age at first sex *n*=1,003		Number of past-year partners *n*=1,017		Condom use consistency *n*=941	
	OR (95% CI)	*p*	*b* (95% CI)	*p*	*b* (95% CI)	*p*	OR (95% CI)	*p*
Associations between pubertal timing and sexual behavior								
Age at menarche	0.87 (0.78, 0.96)	**.01**	0.12 (0.05, 0.18)	**.002**	-0.00 (-0.07, 0.07)	.91	0.98 (0.84, 1.13)	.79
ELA, pubertal timing, and sexual behavior model								
Threat-related experiences								
Indirect effect[a]	1.01 (1.00, 1.03)	.15	0.00 (-0.01, 0.01)	.43	0.00 (0.00, 0.00)	.96	1.00 (0.99, 1.02)	.81
Direct effect[b]	1.93 (1.70, 2.19)	**<.001**	-0.17 (-0.26, -0.08)	**<.001**	0.14 (0.07, 0.20)	**<.001**	0.72 (0.60, 0.83)	**<.001**
Total effect[c]	1.95 (1.72, 2.22)	**<.001**	-0.17 (-0.26, -0.08)	**<.001**	0.14 (0.07, 0.20)	**<.001**	0.73 (0.60, 0.83)	**<.001**
Deprivation-related experiences								
Indirect effect[a]	1.00 (0.99, 1.02)	.88						
Direct effect[b]	1.69 (1.33, 2.05)	**<.001**						
Total effect[c]	1.69 (1.34, 2.05)	**<.001**						

Note: All models adjusted for body mass index, age, race and ethnicity, and family income (household income-to-poverty ratio). Sample sizes varied given differential responses across items.

[a]Effect of ELA dimension on sexual behavior through age of menarche.

[b]Effect of ELA dimenson on sexual behavior when accounting for age of menarche.

[c]Effect of ELA dimension on sexual behavior.

Supplementary Table 6. Associations Between ELA Experiences, Menarche, and Sexual Behavior in Adolescent Girls with Age at Menarche ≥10 Years

	Ever engaged in sex *n*=4,671		Age at first sex *n*=969		Number of past-year partners *n*=983		Condom use consistency *n*=916	
	OR (95% CI)	*p*	*b* (95% CI)	*p*	*b* (95% CI)	*p*	OR (95% CI)	*p*
Associations between pubertal timing and sexual behavior								
Age at menarche	0.86 (0.78, 0.95)	**.005**	0.12 (0.05, 0.18)	**.002**	0.00 (-0.06, 0.06)	>.99	0.99 (0.86, 1.13)	.83
ELA, pubertal timing, and sexual behavior model								
Threat-related experiences								
Indirect effect[a]	1.01 (1.00, 1.02)	.22	0.00 (-0.02, 0.01)	.48	0.00 (0.00, 0.00)	.87	1.00 (0.99, 1.01)	>.99
Direct effect[b]	1.97 (1.73, 2.29)	**<.001**	-0.18 (-0.26, -0.09)	**<.001**	0.14 (0.07, 0.21)	**<.001**	0.64 (0.46, 0.78)	**<.001**
Total effect[c]	1.99 (1.74, 2.30)	**<.001**	-0.18 (-0.27, -0.09)	**<.001**	0.14 (0.07, 0.20)	**<.001**	0.64 (0.46, 0.78)	**<.001**
Deprivation-related experiences								
Indirect effect[a]	1.01 (1.00, 1.02)	.47						
Direct effect[b]	1.60 (1.25, 1.98)	**.001**						
Total effect[c]	1.60 (1.27, 1.99)	**.001**						

Note: All models adjusted for age, race and ethnicity, and family income (household income-to-poverty ratio). Sample sizes varied given differential responses across items.

[a]Effect of ELA dimension on sexual behavior through age of menarche.

[b]Effect of ELA dimension on sexual behavior when accounting for age of menarche.

[c]Effect of ELA dimension on sexual behavior.

Supplementary Table 7. Associations Between Pre-menarche Threat-related ELA Experiences, Menarche, and Sexual Behavior in Adolescent Girls

	Ever engaged in sex *n*=4,815		Age at first sex *n*=1,024		Number of past-year partners *n*=1,040		Condom use consistency *n*=963	
	OR (95% CI)	*p*	*b* (95% CI)	*p*	*b* (95% CI)	*p*	OR (95% CI)	*p*
Threat-related experiences								
Indirect effect[a]	1.01 (1.00, 1.03)	.13	-0.00 (-0.02, 0.02)	.75	-0.00 (0.00, 0.00)	.95	1.00 (0.98, 1.02)	>.99
Direct effect[b]	2.46 (2.04, 3.08)	**<.001**	-0.26 (-0.40, -0.12)	**<.001**	0.19 (0.07, 0.32)	**.002**	0.66 (0.49, 0.80)	**<.001**
Total effect[c]	2.49 (2.06, 3.15)	**<.001**	-0.27 (-0.41, -0.12)	**<.001**	0.19 (0.07, 0.32)	**.002**	0.66 (0.49, 0.80)	**<.001**

Note: All models adjusted for age, race and ethnicity, and family income (household income-to-poverty ratio). Sample sizes varied given differential responses across items.

[a]Effect of ELA dimension on sexual behavior through age of menarche.

[b]Effect of ELA dimension on sexual behavior when accounting for age of menarche.

[c]Effect of ELA dimension on sexual behavior.

Study 2

Couple-level manifestations of posttraumatic stress symptoms and maternal and paternal relationship functioning during the postpartum period

Abstract

Purpose: Posttraumatic stress disorder (PTSD) is linked with impaired intimate relationships in postpartum women, yet less is known about couple-level manifestations of posttraumatic psychopathology—and their potential associations with relationship functioning—during this high-stress time. Examining dyadic patterns of posttraumatic stress in couples may reveal typologies that could hold relevance for promoting maternal and paternal relationship health.

Methods: Data were drawn from a predominately low-income sample of different-gender couples (*N*=867). Both mothers and fathers independently completed PTSD symptom assessments and subjective and objective indicators of relationship functioning six months following the birth of a child. Two analytic methods—a data-driven dyadic latent profile analysis and a hypothesis-driven *a priori* categorization approach—evaluated whether discrete subgroups of couples could be identified based on both partners' PTSD symptoms; structural equation models then tested associations between the identified subgroups across these methods with 1) self-reported relationship quality and 2) interviewer-rated relationship stress. I hypothesized that four couple-level groupings would emerge, including subgroups characterized by partner concordance in PTSD symptoms (*both low, both high*) and symptom discordance (*mother low—father high, mother high—father low*). I anticipated greater relationship dysfunction among individuals in dyads where one or both partners reported elevated posttraumatic stress symptoms.

Results: Three couple-level PTSD symptom groupings were common to both analytic methods: *both low*, *mother low—father high,* and *mother high—father low*. Dyad-level PTSD symptom patterns were differentially related to maternal and paternal relationship dysfunction; across both analytic methods, individuals in dyads characterized by elevations in PTSD symptoms consistently exhibited greater relationship dysfunction compared to dyads where both partners

had low symptom levels. This pattern was observed across both genders and relationship functioning assessments. Findings regarding the relevance of which partner had elevated symptoms for relationship functioning in PTSD symptom discordant couples were mixed. Although the symptom discordant groups did not differ from each other in relationship functioning when using the data-driven approach, individuals in the symptom discordant groups according to the hypothesis-driven categorizations generally exhibited greater relationship dysfunction when they (versus their partner) were high in symptoms.

Conclusion: Couple-level typologies of PTSD symptom manifestations can be identified using both data- and hypothesis-driven approaches, with generally concordant results. Individuals in dyads where at least one partner endorsed elevated posttraumatic distress exhibited poorer relationship functioning than their counterparts in couples where both had minimal symptoms. Patterning of posttraumatic stress at the couple-level is relevant to partner relationship functioning during the postpartum period, which may have implications for interventions to improve maternal and paternal health during this transitory time.

Introduction

Intimate relationships during the perinatal period have important implications for health. For example, relationship distress is linked both cross-sectionally and longitudinally with symptoms of depression and anxiety in both the general population (Whisman, 2013; Whisman & Baucom, 2012) and among pregnant and postpartum women specifically (Whisman et al., 2011). Posttraumatic stress disorder (PTSD)—the sentinel stress-related mental health condition—is increasingly recognized as an important psychological concern for this subgroup, with 4-6% of perinatal women affected (Yildiz et al., 2017). Furthermore, recent research has linked maternal PTSD symptoms with adverse relationship health. Indeed, in postpartum women, PTSD symptom severity was longitudinally linked with subsequent perpetration of intimate partner violence in (Marshall et al., 2019), as well as cross-sectionally associated with lower satisfaction with and greater stress in the partner relationship (Thomas et al., 2021). However, focusing solely on maternal psychopathology limits understanding of posttraumatic stress symptoms in couples and related relationship functioning during this transitory time. Studies that adopt a dyadic approach—in that they consider both partners' psychological health—provide a more comprehensive understanding of couple-level processes. Indeed, such dyadic research demonstrates that symptoms of depression and anxiety in couples prior to parenthood predict declines in both partners' relationship satisfaction from pregnancy through over two years postpartum (Trillingsgaard et al., 2014), though research on PTSD in couples during this time is minimal. Modeling PTSD symptoms and their relational sequelae among couples during the transition to parenthood—a critical life juncture, during which social support serves a protective function for both maternal (Dunkel Schetter, 2011) and paternal (Wang et al., 2021) mental health—may clarify these dyadic patterns and inform targeted interventions.

Trauma, PTSD, and Intimate Relationships

Empirical efforts to elucidate connections between trauma and related psychopathology with intimate relationships—most of which has adopted an individual-level approach, in that only one person's trauma history, symptomatology, and relationship factors are assessed—have demonstrated that trauma-related factors are linked to adverse relationship health. For example, results from the seminal Adverse Childhood Experiences (ACEs) survey reveal that exposure to early life trauma—in the form of receiving or witnessing violence in the home—is related to both victimization and perpetration of violence in later-life intimate partner relationships (Whitfield et al., 2003). Other work leveraged U.S. population-representative data from the National Comorbidity Survey and found that individuals exposed to childhood trauma were more likely to report marital disruption—defined as current separation or current or prior divorce—and lower marital satisfaction than their non-exposed counterparts (Whisman, 2007). Though these study designs are cross-sectional, similar patterns have also been documented longitudinally; in one 30-year study of early life factors and development, survivors of severe childhood sexual abuse were more likely to endorse relationship instability—defined as more frequent cohabitation with various partners, as well as higher rates of perpetrated IPV—and lower relationship satisfaction in adulthood (Friesen et al., 2010).

These findings extend from trauma exposure to related psychopathology, such that survivors experiencing posttraumatic distress are also at-risk for adverse relationship functioning. One early study in this area, again leveraging data from the National Comorbidity Survey, found that PTSD as diagnosed prior to marriage was associated with elevated odds of subsequent divorce (Kessler, Walters, & Forthofer, 1998). Subsequent meta-analytic evidence supports an association between posttraumatic psychopathology and other relationship-relevant

constructs. In a meta-analysis of 31 studies that assessed PTSD and a relationship problem variable (e.g., relationship quality, aggression, discord), Taft and colleagues (2011) found evidence for moderate effect sizes for associations between PTSD and the trauma survivor's perceived relationship quality and self-reported degree of aggression toward their intimate partner. Another meta-analysis opted to aggregate studies examining associations between survivors' PTSD symptoms and their *partners'* perceived relationship quality and psychological health (Lambert et al., 2012), the results of which supported associations of small and medium effect sizes, respectively. Across these meta-analyses, the majority of reviewed studies were cross-sectional and conducted in samples of trauma-exposed veteran men and their women partners. Moreover, by design, the reviews focused both on only one partner's PTSD symptoms and only one partner's relationship-related constructs. Yet taken together, the results suggest that trauma-related psychopathology may be relevant for both survivors and their intimate partners—highlighting the value of a dyadic approach that simultaneously considers both individuals.

Theoretical Rationale for Studying PTSD and Couple Relationships

The finding that posttraumatic stress is linked with relationship problems in both survivors and their intimate partners is well-aligned with conceptual models that consider trauma-related factors from a systemic perspective. For example, the Couple Adaptation to Traumatic Stress (CATS) model (Goff & Smith, 2005)—based in systems theory—asserts that trauma-related sequelae (e.g., psychopathology symptoms, behavioral problems) affect both survivors and their partners individually, as well as the couple relationship as a whole. The theory presumes that following trauma exposure, a survivor's posttraumatic symptoms or functioning—which can vary as a function of that individual's pre-disposing factors and psychological resources—sets in motion a systemic response within their intimate relationship.

Partners of survivors may subsequently develop trauma-related difficulties as a function of this exposure and their own individual-level factors (e.g., age, gender, mental health, coping efficacy, prior trauma exposure), which can then contribute to or maintain the survivor's trauma-related dysfunction. The responses of both partners thus influence one another, as well as the couple relationship as a whole, through a cyclical and mutually reinforcing process.

Despite its acknowledgement of the systemic nature of trauma and that partners' individual-level factors could include their own trauma history, research adopting the CATS model often considers only one individual in a couple as trauma-exposed (i.e., the primary "survivor"). In this conceptualization, trauma-related sequelae in the second partner is often classified as "secondary" traumatic stress, a term that captures trauma-related symptoms that emerge in individuals not directly exposed to trauma (Figley, 1995). This interpretation—that an individual's posttraumatic stress symptoms are due to their partner's, rather than their own, trauma history—may be accurate in some couples, but considering only one partner in a couple as trauma-exposed—and subsequently measuring only one individual's PTSD symptoms—overlooks the possibility that both partners may be survivors and experiencing posttraumatic psychopathology. Indeed, most research on traumatic stress in intimate relationships—including research that does not explicitly adopt the CATS framework, such as studies chronicled in the aforementioned meta-analyses (Lambert et al., 2012; Taft et al., 2011)—only includes trauma and PTSD assessments of one partner. Moreover, trauma exposure, the necessary precursor to posttraumatic distress, is common in the general population, with 50-89% experiencing at least one traumatic event in their lifetime (Benjet et al., 2016; Kessler et al., 1995; Kilpatrick et al., 2013). Thus, the likelihood that both individuals in a couple have experienced trauma is high, and it is conceivable that two trauma-exposed individuals may partner with one another—which,

aligned with the CATS model, may contribute to poor relationship health. Adopting a dyadic approach, wherein both partner's trauma histories and posttraumatic psychopathology symptoms are modeled in tandem, may reveal important considerations for relationships.

Trauma-Related Factors and Partner Similarity

The notion that both individuals in a couple subsystem may be trauma survivors is well-aligned with the notion of assortative mating, or the non-random selection of romantic partners based on shared characteristics. Most research on assortative mating with regard to psychopathology is relatively dated, with initial studies first conducted forty years ago. This literature has examined couple similarity in diverse forms of psychopathology and found evidence for assortment within married couples for both general psychopathology (e.g., Butterworth & Rodgers, 2006; Dubuis-Stadelmann et al., 2001) and specific forms of it (Maes et al., 1998; Merikangas, 1982). For example, research substantiates symptom concordance—one way in which assortative mating is operationalized—in couples with mood (for meta-analysis on major depressive disorder, see Mathews & Reuus, 2001), anxiety (e.g., social phobia, agoraphobia, generalized anxiety disorder in Nordsletten et al., 2016), neurodevelopmental (e.g., autism spectrum disorder, attention-deficit hyperactivity disorder in Nordsletten et al., 2016), and substance use disorders (Low et al., 2007).

Applying this framework to trauma-related factors, it may be that both individuals in a couple survived trauma prior to initiating their romantic relationship and that subsequent posttraumatic stress at the dyad-level is compounded by this combination of histories. This phenomenon, known as "dual trauma couples" in the clinical literature (Balcom, 1996), has received relatively limited empirical attention, though some research exists. In one population-based study of over 2,000 married couples comprised of individuals over the age of 50, exposure

to a select traumatic experience (e.g., life-threatening illness/accident, natural disaster, combat, assault, childhood maltreatment) in one partner was associated with higher likelihood of their partner reporting the same trauma (odds ratios 1.53-7.85 across traumas; Whisman et al., 2014), suggesting couple similarity. Importantly, this study was cross-sectional, thereby precluding claims around causality; however, by definition, exposure to childhood maltreatment occurred prior to marriage, thereby lending credence to the possibility of assortative mating. In one clinical study of Vietnam-era veteran men, those with (versus without) PTSD were more likely to be partnered to women with PTSD (Riggs et al., 2014). Moreover, nearly all (92%) of these relationships were initiated following the veterans' return from deployment, and all women with PTSD reported exposure to trauma outside of violence in the current intimate relationship—providing suggestive evidence of assortative mating due to trauma-related factors. Nevertheless, in contrast to these findings, another population-based study that examined spousal concordance for lifetime history of a multitude of psychological conditions (*N*=519 dyads) did not find any couples to be concordant for PTSD (Galbaud du Fort et al., 1998). However, this study also utilized *DSM-III*'s diagnostic criteria for PTSD, which differs conceptually from later iterations.

Couple Similarity and Couple Heterogeneity

The prevalence and severity of trauma exposure and related psychopathology can also vary between partners, manifesting as either concordance or discordance in trauma-related factors at the dyad level. A recent dissertation, conducted in a sample of primarily different-gender couples recruited from a training clinic (*N*=146), addressed this possibility by examining couple concordance versus discordance in childhood trauma through a cluster analysis (Redd, 2017). Specifically, the researcher investigated whether subgroups of couples based on both partners' ACE scores—a measure of cumulative trauma exposure during childhood—would

emerge. Three subgroups—including one group of couples concordant in partners' low ACE scores and two groups where partners within couples reported discrepant ACE exposure (e.g., medium versus high)—were identified, thereby highlighting the existence of different types of dyads based on trauma-related factors.

Couple-level concordance versus discordance in such factors may have implications for relationship health. However, research is mixed regarding whether couples discordant in trauma-related factors—wherein only one partner is considered trauma-exposed or exhibits elevated PTSD symptoms—fare better or worse than their dual trauma counterparts. Notably, only a few studies exist in this area, and most utilize small and circumscribed samples (e.g., military-affiliated). In one of the larger studies on this topic, 161 different-gender couples recruited from a marital therapy clinic self-reported their trauma histories and relationship satisfaction; couples where one or both partners endorsed a trauma history reported less relationship satisfaction than couples without an abuse history (Nelson & Wampler, 2000), again highlighting the importance of trauma-related factors in relationships. However, relationship satisfaction between dual and single trauma couples—wherein only the man or woman reported an abuse history—was equivalent (Nelson & Wampler, 2000). In the aforementioned dissertation, the researcher also examined relationship satisfaction as a correlate of couple-level patterning in ACEs, and findings similarly supported relative equivalence across different couple typologies (Redd, 2017). Specifically, relationship satisfaction between the two subgroups of couples discordant in cumulative childhood trauma—where either the man or woman partner reported greater exposure than the other partner—was equivocal, and the relationship satisfaction reported by couples where both partners reported minimal ACE exposure was only marginally better than that reported by discordant couples (Redd, 2017). However, an important methodological note is that

relationship satisfaction scores in this study were averaged across both partners, thereby limiting understanding of if couple-level ACE scores were differentially linked with partners' individual-level relationship metrics.

In contrast to these findings, in another study of 35 married different-gender couples (46% military-affiliated), husbands' PTSD symptoms were linked with lower levels of relationship satisfaction for both themselves and their wives in the dual trauma, but not single trauma, dyads (Ruhlmann, Gallus, & Durtschi, 2018)—suggesting differential effects of trauma-related factors whereby couples with discordant trauma histories exhibited better functioning than trauma concordant couples. Qualitative work has yielded similar results; an interview study of 22 single and dual trauma couples found that while both groups attributed some relationship strengths to trauma (e.g., support), dual trauma couples described more post-trauma relationship difficulties (e.g., communication problems, trauma triggers; Nelson Goff et al., 2014).

Heterogeneity was also observed in a recent dyadic study of women and men veterans with PTSD and their significant others (N=206; Khalifian et al., 2022). In this cross-sectional study, cumulative childhood trauma exposure—as also indexed by the ACE measure—was moderately correlated within couples, suggesting some level of trauma-related concordance. Both gender and veteran (versus civilian) status moderated associations between childhood trauma burden and relationship satisfaction; women veterans—who endorsed an average of 5.53 exposures, the most of any of the other subgroups studied (e.g., veteran men)—reported higher relationship satisfaction when their non-veteran partners endorsed greater childhood trauma, suggesting a protective role of concordance. In contrast, civilian men—for whom trauma exposure was relatively low, on average—reported lower relationship satisfaction when their veteran partners endorsed greater trauma. These findings—wherein concordance in trauma-

related factors proved protective for relationship health for one, but not both, individuals in a couple—suggest that considering individual-level characteristics (e.g., gender) in these associations may be warranted.

Considering Potential Gender Differences

Conflicting findings regarding the significance of couples' trauma-related concordance for relationship health begs an important question: for discordant couples, does it matter *which* individual in a couple endorses trauma exposure or greater PTSD symptoms? In dyads distinguishable by gender, it follows that the gender of the individual with elevated PTSD symptoms within the dyad may be pertinent to partners' relationship functioning. Gender-based predictions may feel particularly salient in the context of trauma-related psychopathology, given higher prevalence of PTSD in women compared to men (Kessler et al., 1995). At the same time, gender differences in this space are not absolute; research into specific types of traumatic experiences (e.g., childhood abuse) and among specific populations (e.g., combat-exposed veterans) demonstrates the risk for PTSD development to be equivocal across women and men (e.g., Street et al., 2013). These findings have prompted researchers to consider how gender differences in posttraumatic psychopathology may have been overgeneralized, insofar as that conclusions about women's relative risk have been insensitive to how gender socialization and social norms shapes these factors (Street & Dardis, 2018).

Aligned with this, feminist psychologists caution against gender essentialism, or the premise that women and men are fundamentally different from one another. Indeed, data show that in most ways, women and men are more similar to one another than different, a phenomenon known as the gender similarities hypothesis. In her seminal paper outlining gender similarities, Hyde (2005) aggregated 46 meta-analyses considering differences between women and men

across diverse psychological constructs (e.g., cognitive capacities, communication behaviors, coping), finding over three-quarters of effect sizes to be small-to-moderate (e.g., between 0 and .35). The similarities hypothesis has also been borne out with regard to relationship functioning. In a meta-analysis of 226 samples, Jackson and colleagues (2014) found small gender differences in marital satisfaction, with women reporting slightly lower satisfaction than men. Importantly, moderator analyses revealed that these differences were driven by inclusion of clinical samples (e.g., couples in marital therapy), and there were no significant gender differences in community-based samples. Moreover, most longitudinal studies considering associations between mental health and partner relationships find no significant gender differences when they are formally tested (e.g., for depression: Davila et al., 2003; Whisman & Uebelacker, 2009; for anxiety, Whisman, Uebelacker, & Weinstock, 2004; for PTSD, Creech et al., 2019; Smith et al., 2017; Vogt et al., 2017), thereby lending additional support to minimal gender differences.

To my knowledge, only one study of PTSD and relationship functioning in perinatal couples has considered potential gender differences, and results were somewhat unexpected; specifically, the authors found the association between an individual's PTSD symptoms and their partner's self-reported couple functioning to be stronger in men than women, but only when men received a couple-based co-parenting intervention (Fredman et al., 2017). It may be that as a result of the intervention, fathers experienced increased attunement to their partners' psychological health and to the state of the intimate relationship more broadly. However, without more research examining these relationships in additional samples—including those who have not received interventions—these findings may be considered preliminary at best.

Taken together, evidence supports the gender similarities hypothesis as applied to how PTSD may influence relationship functioning. At the same time, given the salience of

sociocultural expectations and family-related identity for women during the perinatal period (e.g., assimilating into the mother role), it would not be unreasonable to expect some gender-based differences in relationship functioning to emerge in couples navigating the transition to parenthood. This view is compatible with social structural theory (Eagly & Wood, 1999), which posits that the social roles individuals hold influence the psychological qualities and related behaviors they exhibit. As applied to the perinatal period, women experience different cultural expectations for motherhood than men do for fatherhood; biologically, women and men also experience varying amounts and types of investment during and beyond pregnancy (e.g., carrying a child, breastfeeding). Thus, gender-based divergences—whether small or large in magnitude or clinical significance—can also be understood as related to the sociocultural salience of gender-aligned identities (e.g., mother, father) during particular life transitions. In this vein, some research suggests that family identity salience shifts more for mothers than fathers following the birth of a child (Katz-Wise, Preiss, & Hyde, 2010); thus, it is conceivable that postpartum women may be particularly attune to partner relationship dynamics—and thus less satisfied with the relationship more broadly—than men during this discrete time.

Analytic Approaches to Consider Patterns in Couples' Posttraumatic Stress

Most couples research—including most literature on PTSD in couples reviewed above, with some notable exceptions (e.g., Nelson & Wampler, 2000; Redd, 2017)—employs the actor-partner interdependence model (APIM), often considered the gold standard approach in working with dyadic data (Kenny, Kashy, & Cook, 2006). The APIM's primary aim is to test the degree to which an individual's outcome is predicted by their own characteristics ("actor" effect) and by those of their partner ("partner" effect), holding constant the effects of each. In this way, the APIM—while it incorporates data from both partners within a dyad—answers individual-level

research questions. For example, this analytic method can assess to what degree an individual's PTSD symptoms are linked with their relationship functioning while accounting for their partner's PTSD symptoms; however, it cannot test associations between PTSD manifestations at the *couple*-level and individuals' relationship functioning, as the unit of analysis for both the independent and dependent variables are anchored at the individual-level. This approach, while informative, cannot address research questions around dyad-level considerations, such as elucidating potential couple-level patterns of trauma-related psychopathology (e.g., couple-level concordance versus discordance in PTSD).

An alternative method through which to consider examining dyadic patterns of trauma-related psychopathology in couples is through latent classification methods, including latent class analysis (LCA) and latent profile analysis (LPA). These person-centered analytic approaches differ from more traditional variable-centered methods, in that they focus on empirically identifying homogenous subgroups within the broader population. While LCA relies on categorical indicators upon which these groups are divided, LPA draws on continuous ones, thereby retaining a greater amount of variance. While less commonly applied to dyadic data, a growing amount of research has considered these methods in the context of couples. By including indicators drawn from each partner, latent profiles representing discrete subgroups of couples based on these constructs are then formed. Moreover, unlike the APIM's focus on linear relationships between variables within couples and its subsequent adjustment for interdependence in these factors, latent classification analyses emphasize capturing heterogeneity across and within dyads—thereby marking them as viable methods through which to consider concordance versus discordance at the couple level.

Most existing work has constructed dyadic latent profiles based on psychological (e.g., personality traits; Wang, Kim, & Stokes, 2020) or attitudinal (e.g., perspectives on gender-related issues; Cao et al., 2019) characteristics. Following latent profile identification, researchers are often interested in examining associations between these emergent subgroups and important indicators of relationship health and functioning, including marital satisfaction (Cao et al., 2019; Wang et al., 2020; Wood et al., 2015) and sexual behavior (Vasilenko, 2022). Only one latent classification study to date has specifically aimed to elucidate couple categorizations based on both partners' mental health symptoms. This research, conducted in a sample of different-gender couples, found evidence for four profiles, including two profiles characterized by symptom concordance (e.g., both partners high in symptoms of depression and anxiety, both partners low in symptoms) and the remaining characterized by discordance (e.g., man higher in symptoms, woman higher in symptoms; Wu et al., 2022).

To my knowledge, only one study has utilized a latent classification approach to specifically examine posttraumatic stress symptoms within dyads, and this study was conducted in a sample of IPV-exposed women and their children (Galano et al., 2020). Using LPA, the authors found evidence for two profiles based on both informants' PTSD symptoms, with mothers and their offspring in each profile reporting similar scores to one another—or relative symptom concordance—in each subgroup, with one high and one low. Based on prior research highlighting the heterogeneity of trauma-related experiences in couples, it follows that adopting a similar analytic approach in these types of dyads may reveal subgroups characterized by symptom concordance and discordance. Better understanding of the subgroups of couples that exist in a population may then be useful for tailoring relationship interventions, including those that specifically target mental health in couples.

Mental Health (Depression, Anxiety, and PTSD) in Couples During the Perinatal Period

Most research on mental health in postpartum couples has focused on co-occurring maternal and paternal depression (Paulson & Bazemore, 2010; Smythe, Petersen, & Schartau, 2022; Thiel et al., 2020, Thomas & Dunkel Schetter, 2023). Indeed, a recent meta-analysis established that both mothers and fathers experience depression in up to 3% of couples during pregnancy and postpartum (Smythe, Petersen, & Schartau, 2022). While the authors originally intended to aggregate findings regarding both depression and anxiety in perinatal couples, the limited number of studies simultaneously assessing paternal and maternal anxiety precluded this analysis. To my knowledge, this paper represents the first attempt to synthesize literature on dyad-level manifestations of psychopathology during the perinatal period, and its publication represents a call for more research on psychological symptom concordance in these populations.

In contrast to this dyad-level synthesis, most research on posttraumatic stress during the perinatal period focuses on mothers' experiences of childbirth-related PTSD—or posttraumatic stress symptoms anchored to the delivery experience (for reviews on this construct, see Dekel, Stuebe, & Dishy, 2017; Olde et al., 2006). This work was predominately qualitative until relatively recently (for a review, Delicate et al., 2017), and quantitative attention to it is growing; indeed, a recent meta-analysis identified 154 papers on childbirth-related PTSD (Heyne et al., 2022). Of those papers identified, only 11 studies considered both maternal and paternal posttraumatic stress symptomatology, again highlighting the relative dearth of literature adopting a couple-level approach to perinatal psychopathology.

Studies that do evaluate both maternal and paternal PTSD symptoms—including research on posttraumatic stress symptoms not necessarily anchored to a traumatic labor or delivery—have demonstrated within-couple associations, in that symptoms between mothers and fathers are

significantly correlated, albeit with small (e.g., .23 in Fredman et al., 2017; .28 in Iles et al., 2011) to moderate (.50 for avoidance symptoms in Ayers et al., 2007) effect sizes. Importantly, while these correlations speak to how strongly individuals within couples are related to one another on average in these samples, these data do not capture couple-level couple concordance or discordance in PTSD symptoms, per se. A dyad-level classification approach that simultaneously considers similarity and divergence of both partners' PTSD symptoms would more aptly capture these patterns.

Mental Health (Depression, Anxiety, and PTSD) and Couple Relationship Satisfaction During the Perinatal Period

While having a baby can be a joyous event for romantic partners, it can also be a stressful time that introduces unique challenges to the couple relationship. For example, both mothers and fathers must shift their family roles and responsibilities following childbirth, and this may influence the richness and quality of the partner relationship. Indeed, parents often report increased stress and worry after the birth of a child, as well as participation in fewer joint social activities and less partner support (Lawrence et al., 2008). Meta-analytic evidence supports these trends, documenting that relationship satisfaction for both women and men declines during the transition to parenthood (Bogdan, Turlic, & Candel, 2022; Twenge, Campbell, & Foster, 2003).

Perinatal mental health issues may exacerbate this strain on the couple relationship during an already transitory time. However, as noted above, most research considering psychopathology during the perinatal period has focused solely on maternal mental health, a trend that extends to research that considers psychopathology and couple relationship factors. This individual-level approach—which typically involves women reporting their own mental health symptoms and their own relationship satisfaction—evinces negative associations between these constructs.

Indeed, meta-analytic evidence supports a robust association between depression and relationship distress in postpartum women (Beck 1996, 2001), while other work has examined the link between maternal anxiety and relationship adjustment (Whisman et al., 2011). Recent research has investigated links between maternal PTSD symptoms and partner relationship factors, specifically. In a mixed-gender convenience sample oversampled for traumatic births, maternal PTSD symptoms were cross-sectionally associated with poor dyadic adjustment, as measured through a self-report scale assessing couple cohesion, satisfaction, consensus, and affective expression (Parfitt & Ayers, 2009). More recently, a large, population-based study found that maternal postpartum PTSD symptoms prospectively predicted low couple relationship satisfaction—again, as self-reported by women only—two years post-delivery (Garthus-Niegel et al., 2018). However, as noted above, one drawback of relying on single informants is that questions remain regarding the other partner's potential contributions to these associations.

Indeed, few studies have dyadically examined mental health and relationship functioning among coupled women and men during the perinatal period. This research has extended the individual-level findings noted above and identified links between both partners' psychological symptoms—primarily symptoms of depression or anxiety—and their relationship factors. For example, in one study of couples surveyed at multiple timepoints throughout pregnancy and postpartum, greater symptoms of prenatal depression and anxiety predicted larger declines in relationship satisfaction over time—an effect observed for both women and men (Trillingsgaard et al., 2014). In a longitudinal study of 136 couples recruited from prenatal clinics, depressive symptoms in both mothers and fathers during pregnancy predicted worse relationship functioning for both partners in the two years following birth (Cox et al., 1999). A more recent study examined 208 first-time parents throughout the perinatal period and found that moderate

and stable levels of anxiety were associated with lower relationship satisfaction in both women and men (Don et al., 2014).

Even less work has adopted a dyadic approach with regard to PTSD symptoms and relationship functioning in couples during the perinatal period. To date, only two studies have examined these questions in perinatal populations, and findings somewhat contradicted one another. One, a cross-sectional study of 64 couples assessed at 9 weeks postpartum, only measured intrusion and avoidance PTSD symptoms; these symptoms were significantly correlated within-couples (effect sizes .37—.50), highlighting a trend toward concordance in the broader sample. However, it is unknown whether distinct subgroups of couples based on both partners' PTSD symptoms—for example, couples concordant in levels of PTSD symptoms versus discordant in symptom levels—may have been able to be meaningfully identified. Moreover, in this study, neither maternal nor paternal PTSD symptoms were linked with either partner's self-reported relationship satisfaction (Ayers et al., 2007), a somewhat surprising finding inconsistent with prior work. Though these results should be interpreted cautiously given methodological concerns (e.g., small convenience sample, limited measure of PTSD symptoms, no statistical adjustment for within-couple interdependence), it may be that partners' concordance in these specific PTSD symptom clusters served a protective function for relationship health, which could explain why no associations were detected. However, as the authors did not directly test for differential effects based on partners' PTSD concordance versus discordance at the couple-level, this is merely a hypothesis.

The other study considering couples' posttraumatic psychopathology and relationship functioning, conducted in a sample of 250 predominantly married couples 10 months after birth, demonstrated a small-to-moderate correlation (effect size: .23) between maternal and paternal

PTSD symptoms (Fredman et al., 2017), again suggesting relative concordance in trauma-related symptomatology in the broader sample. Using the APIM, the authors then demonstrated that both partners' PTSD symptoms were negatively associated with their own and their partner's perceived couple functioning, operationalized as a latent factor inclusive of conflict communication, relationship efficacy, marital quality, sexual satisfaction, and co-parenting adjustment (Fredman et al., 2017). These findings were more consistent with the broader literature on posttraumatic psychopathology in couples and suggest that trauma-related psychopathology in both partners is relevant to relationship functioning. However, as with Ayers et al. (2007), it is unknown whether associations may have differed according to whether partners were concordant or discordant in PTSD symptoms, as the independent variables were structured at the individual-level (e.g., maternal PTSD symptoms, paternal PTSD symptoms) rather than at the couple-level.

Further, similar to most work on psychopathology in couples, both of these study samples were predominantly non-Hispanic White; while Ayers et al. (2007) did not report income, the couples sampled by Fredman et al. (2017) were of middle-to-high socioeconomic status (median household income: $87,500). Questions thus remain regarding generalizability of findings to more diverse perinatal samples, as low-income couples are at particular risk for relationship dysfunction and dissolution (Lundberg, Pollack, & Stearns, 2017), and disadvantaged populations are less likely to receive interventions for both PTSD (McClendon, Dean, & Galovski, 2020; Roberts et al., 2011) and relationship problems (Sullivan & Bradbury, 1997).

Objective of the Present Study

To date, most research on posttraumatic stress and intimate relationships has adopted an individual-level approach, wherein only one partner's trauma history, PTSD symptoms, and

relationship metrics are assessed. While studies that adopt a dyadic framework—in that they assess trauma-related factors and relationship health in both individuals within a couple—are growing, this research has yielded mixed findings regarding whether couples who are concordant in trauma-related factors (e.g., both have history of trauma exposure, endorse elevated posttraumatic stress) exhibit less optimal relationship functioning relative to discordant couples (e.g., only one partner has trauma history, reports elevated PTSD symptoms). Moreover, most of this work—while it is dyadic in that it incorporates data from both partners—has adopted analytic methods (e.g., the APIM) that still retain the individual as the unit of the analysis. While valuable, this analytic approach limits understanding of associations between PTSD presentations at the *dyad*-level and partners' relationship functioning. To my knowledge, no research has examined couple-level PTSD symptom manifestations and maternal and paternal relationship functioning in perinatal populations. Greater understanding of couples' symptoms of posttraumatic distress—and potential associations between these dyadic manifestations and relationship functioning and health—may reveal important targets that can be addressed in tailored interventions to disseminate during this particular life stage.

Toward that end, in this study, I investigated couple-level manifestations of posttraumatic stress symptoms and associations with relationship functioning in a sample of low-income and racially and ethnically diverse couples during the postpartum period. To address key gaps in the literature, I examined two research questions.

First, I aimed to assess if distinct subgroups of couples—based on patterns of both partners' total PTSD symptoms—could be identified. I simultaneously leveraged two analytic methods—a data-driven and a hypothesis-driven approach—to explore this. For the data-driven approach, I employed dyadic LPA to test whether couples could be statistically grouped based on

combinations of both partners' PTSD symptoms. Given its basis on patterns in a dataset, LPA is hypothesis-free. However, extrapolating from extant research on assortative mating among individuals with select mental health diagnoses (e.g., Nordsletten et al., 2016) and among trauma-exposed individuals (Redd, 2017; Whisman, 2014), as well evidence highlighting concordance of "non-psychopathology" in a community-based sample of couples (Low et al., 2007) and concordance and discordance of psychopathology symptoms in a study of couples receiving couple therapy (Wu et al., 2022), I anticipated certain, theoretically relevant subgroups to emerge. Specifically, I predicted subgroups of couples where both partners exhibited elevated PTSD symptoms (*both high*); couples where neither partner exhibited elevated symptoms (*both low*); couples where only the woman exhibited elevated symptoms (*mother high—father low*); and couples where only the man exhibited elevated symptoms (*mother low—father high*). Given limited prior research in this area, I also explicitly modeled these subgroups as *a priori* categorizations in a hypothesis-driven approach. As an exploratory sub-aim, I then tested the amount of overlap between these two dyad classification methods.

My second research aim was to investigate associations between these couple-level categorizations of posttraumatic psychopathology and subjective and objective indices of relationship functioning for each partner. I previously demonstrated among a subset of this cohort that women with higher total PTSD symptom levels exhibited greater interviewer-rated stress in their partner relationship and reported lower relationship quality (Thomas et al., 2021). Based on these findings and the broader literature linking psychopathology with adverse relationship metrics, I hypothesized that couples where one or both partners demonstrate elevated PTSD symptoms (e.g., *both high*, *mother low—father high, mother high—father low*) would have poorer relationship functioning relative to couples where neither partner exhibits

elevated symptoms (e.g., *both low*)—with largest effects observed for PTSD concordant couples (e.g., *both high*).

I also considered the possibility of gender differences in these associations—that is, considering whether couple-level manifestations of posttraumatic psychopathology would be more strongly linked with maternal versus paternal relationship functioning. Aligned with social structural theory, mothers may be more primed to family dynamics than fathers during the perinatal period, given the salience of gender-based sociocultural messages during this time; however, given minimal evidence supporting this versus a preponderance of evidence supporting the gender similarities hypothesis as applied to relationship satisfaction (for meta-analysis, see Jackson et al., 2014), I did not predict gender-based divergences in associations.

Methods

Data for this study were drawn from the Community Child Health Network (CCHN), a community-academic partnership dedicated to the investigation of maternal and child health disparities. Using community-based participatory research methods, CCHN conducted a five-year, prospective study of >2,400 newly postpartum women and >1,700 of the fathers of their children (Dunkel Schetter et al., 2013). Black, Latina, and White mothers were recruited at delivery of a child in one of five U.S. sites, including three urban areas (Los Angeles, CA; Baltimore, MD; Washington, DC), one suburban location (Lake County, IL) and one rural site (counties in eastern North Carolina); fathers were invited to participate with the consent of mothers. Both mothers and fathers were assessed individually at one-month postpartum and then every six months for two years via in-home interviews. Community members trained in methods and academic research staff trained in community research conducted the in-home interviews in

either English or Spanish. Additional information on the CCHN cohort and study design is described elsewhere (Dunkel Schetter et al., 2013; O'Campo et al., 2016; Ramey et al., 2015).

This cross-sectional study leveraged maternal and paternal data from CCHN that was collected six months postpartum, the only timepoint at which PTSD symptoms were assessed. Data on past-year trauma exposure—collected one month after childbirth from both mothers and fathers—were also utilized to lend credence to the available PTSD measure. The final analytic sample was comprised of the 867 couples in which both partners had complete PTSD data.

Measures

PTSD symptoms. At six months postpartum, PTSD symptoms were assessed using the PTSD Checklist-Civilian Version (PCL-C; Blanchard, 1996). Both partners independently indicated how bothered they were by each of 17 *DSM-IV* PTSD symptoms in the past month, with responses rated on a 5-point scale (1=Not at all, 5=Extremely) and summed to create a total symptom severity score (possible range 17-85; Cronbach's α=.91 for women, α=.92 for men). A well-validated and reliable measure (Wilkins et al., 2011), the PCL has been used to assess posttraumatic stress symptoms in perinatal populations (Gelaye et al., 2017; Reichenheim et al., 2018), including a prior study of postpartum women drawn from CCHN (Thomas et al., 2021). I considered total scores $\geq$30, a cut-off that was initially validated in an HMO sample of community-dwelling women (Walker et al., 2002), as representative of potential maternal PTSD based on elevated symptoms. Most PCL validation studies have been conducted in samples of women civilians or veteran men, and a critical review of this literature identified no studies that utilized community-based samples of non-veteran men (McDonald & Calhoun, 2010). Given limited available evidence, I elected to consider $\geq$31 as the cut-off to indicate elevated paternal PTSD symptoms, a cut score identified in a sample predominately comprised of veteran men

(Yeager et al., 2007). These cut-off scores were used for descriptive purposes and for the *a priori* hypothesis-driven grouping approach.

As in most prior research using the PCL (for a review, see McDonald & Calhoun, 2010), the PCL in CCHN was not anchored to a specified index trauma; rather, participants reported symptoms as anchored to "general stressful experiences." Given this limitation, I collated available data from the larger parent study on potential trauma exposures pre-dating the PTSD symptom measure. One month following delivery, mothers and fathers independently completed a Life Events Checklist (Dominguez et al., 2005), where they each indicated stressful events they or close others had experienced over the past year. Consistent with the definition of a *DSM-IV* Criterion A trauma (e.g., individual directly experienced or witnessed event(s) involving actual or threatened death, significant injury, or threat to physical integrity; American Psychiatric Association, 2000), I selected eight events from the checklist as potentially traumatic experiences: serious injury, illness, hospitalization; mugging or assault; death; vehicular accident; threat of physical harm by another person; robbery/burglary; natural disaster; and victim of violent crime. I summed these exposures to create a past-year trauma burden score for both mothers and fathers. As cumulative trauma exposure is linked with greater PTSD symptom severity (Wilker et al., 2015), I then examined correlations between these past-year trauma burden scores and individuals' total PTSD symptoms. Prior work in the larger CCHN sample of women found that past-year traumatic experiences were significantly linked with PTSD symptoms (Thomas et al., 2021), providing suggestive evidence that PTSD symptoms reflected trauma-related sequelae rather than more generalized negative affect. I replicated this analysis within the present study to add validity to both the maternal and paternal PTSD symptoms.

Relationship functioning. Relationship functioning at six months postpartum was indexed by two separate measures: self-reported *relationship quality* (*n*=688) and objectively indexed *partner relationship stress* (*n*=703). Partners separately reported their *relationship quality* using the 32-item Dyadic Adjustment Scale (DAS; Spanier, 1976). The DAS is comprised of four subscales: Dyadic Consensus (degree to which couples agree on topics important to the relationship, e.g., career decisions, household tasks), Dyadic Satisfaction (the degree to which couple is satisfied with their relationship), Dyadic Cohesion (the degree of closeness and shared activities within the couple), and Affective Expression (degree to which couples demonstrate physical affection for one another). Item-level responses are summed to create a total scale score (possible range 0-151), where higher scores indicate more positive relationship adjustment, alternatively referred to as relationship quality (Cronbach's α=.93 for women, α=.92 for men). The DAS is a psychometrically sound measure (Graham et al., 2006) that has been widely used to study partner relationships, including in studies of couple adjustment and PTSD among both veterans (e.g., Gewirtz et al., 2010) and civilians (e.g., Hershkowitz et al., 2017). It has also been shown to be invariant across gender, indicating that it measures the same concept in both women and men (South, Krueger, & Iacono, 2009).

Both partners also independently completed an adapted version of the UCLA Life Stress Interview (LSI), a semi-structured interview of chronic stress in various life domains (Hammen et al., 1987). Modifications to the gold standard LSI were done in partnership with CCHN community partners and interviewers and were piloted prior to implementation. Measure adaptations included shortening the overall interview, simplifying interviewer instructions, and adding and amending questions to be of greater relevance to the study population (e.g., using term "relationship partner" rather than "spouse"). As part of the *partner relationship stress*

domain, both women and men reported on features of their intimate relationship over the past six months, including commitment and stability; closeness, trust and confidence; support and dependability; and conflict resolution. Trained assessors assigned objective stress severity ratings using a 5-point Likert scale of behaviorally concrete anchor points (1=Exceptional relationship that is close and trusting, long-standing and stable, with good conflict resolution; 5=Highly negative relationship that is unstable and uncertain, lacks communication and trust, is physically or emotionally abusive). Higher scores indicated greater partner relationship stress. Intra-class correlations estimating reliability ranged from .64 to .76 for this domain in a subset of mothers (n=272) from the broader CCHN sample (Tanner Stapleton et al., 2016).

Sociodemographic and relationship characteristics. Both mothers and fathers self-reported sociodemographic information at study enrollment, including age, racial and ethnic identity (with mothers categorized as Latina, Black, and non-Hispanic White due to recruitment method; fathers were grouped into the same categories, with an additional "Other" category inclusive of individuals identifying as Asian, American Indian, multi-racial, and other races not identified), highest level of education attained, and income. Mothers also reported parity.

Because this study focused on understanding dyadic patterns of PTSD symptoms and associations with relationship functioning in partners—and due to a rich literature substantiating couple similarity in sociodemographic factors (Luo et al., 2017)—I created dyad-level variables to capture couple-level characteristics for descriptive purposes and, when pertinent, to model as covariates in the structural analyses. These variables included *age*, which involved averaging the age of both partners; *minority racial and ethnic couple status*, a binary variable indicating couples where both partners self-identified as people of color; and *dyad-level education* and *dyad-level poverty*, which respectively captured the highest level of education attained and

highest income level across both members of the couple. I also included a *committed relationship* indicator, which combined marital (married versus not) and cohabitation (living together versus not) status into a single variable; I elected to do so because couples in this study were united by the birth of a baby rather than solely by marriage, thus requiring a more inclusive approach to capture commitment. This combined variable was based on maternal reporting on if she was married to and/or cohabitating with the baby's father, as fathers were not systematically queried on these factors.

Analytic Plan

First, using Mplus Version 8, I conducted dyadic LPA using mothers' and fathers' total PTSD symptom scores as the two continuous indicators. To determine the optimal number of profiles, I compared model fit values across conventional model fit statistics, including log likelihood, Akaike information criterion (AIC; Akaike, 1987), Bayesian information criterion (BIC; Schwarz, 1978), and sample-size adjusted BIC (SABIC; Sclove, 1987). Across these indicators, lower values generally indicate more optimal fit (Ferguson, Moore, & Hull, 2019). Two maximum likelihood tests—the Lo-Mendell-Rubin likelihood ratio test (LMRT; Lo, Mendell, & Rubin, 2001) and the bootstrap likelihood ratio test (BLRT; Nylund, Asparouhov, & Muthén, 2007)—then tested whether systematic addition of subsequent profiles improved overall model fit. Entropy, which measures the distinguishability of profiles generated by each LPA model, was also consulted; plausible values for this indicator range from 0 to 1, where higher numbers reflect higher classification accuracy (Tein, Coxe, & Cham, 2013). I also considered model interpretability, in the form of theoretical relevance and relative size of the emergent typologies (Marsh, Hau, & Wen, 2004). Importantly, with regard to profile size, scholars have recommended that 5% or more of the sample be captured by a particular profile for it to be

reasonably retained (Ferguson et al., 2019). When to include covariates is an ongoing area of discussion in the latent classification literature, as incorporating additional variables into models may alter resultant typologies in theoretically inconsistent ways, and simulation studies support first determining the optimal model prior to considering covariates (Nylund-Gibson & Masyn, 2016). As my primary research question was to explore couple-level patterning of PTSD symptoms, I elected to focus on PTSD symptoms as the sole indicators in the LPAs and to include pertinent sociodemographic covariates in the structural analyses examining associations between the emergent dyadic groupings and relationship functioning measures.

In addition to identifying couple profiles through LPA, I grouped dyads based on *a priori* cut-offs (e.g., both partners exceed cut-off indicative of elevated PTSD symptoms as suggested by the limited literature in this area; neither exceed; one exceeds), in service of exploring whether these hypothesis-driven groupings mapped on to the emergent LPA profiles. As a latent classification method, LPA will always identify subgroups in a dataset, regardless of theoretical relevance of the selected indicator variables upon which those groups are formed. Thus, I aimed to complement this data-driven approach with a theory-driven classification method that capitalized on existing cut-off scores. I then evaluated the degree of overlap between these approaches—that is, considering whether dyads were classified identically across both the data- and hypothesis-driven categorization methods—in an exploratory comparison using descriptive statistics. For both the data- and hypothesis-driven approaches, I also conducted descriptive analyses to characterize the identified subgroups.

Second, using the profile membership classifications and the *a priori* categorizations (e.g., both partners exceed elevated PTSD symptoms cut-off; neither exceed) as predictors, I examined associations between these and the self-reported and interviewer-rated relationship

functioning of both partners through a series of structural equation models (SEMs) in Mplus. As a multivariate technique, SEM can include both latent and manifest variables, as well as adjust for covariance between variables in the event of interdependence. All mothers and fathers in the analytic sample had complete PTSD symptom data; however, some participants were missing data on the relationship functioning correlates (sample sizes noted under *Measures*). Because Mplus can produce maximum likelihood estimations under missing at random conditions, I integrated full information maximum likelihood (FIML) estimation with robust standard errors (MLR); the latter adjusts for interdependence of variables, as is needed in dyadic data.

In these structural models, both sets of independent variables—the profile membership and *a priori* groupings—were coded as dummy variables, with the largest category considered as the reference group in the primary analyses examining links between the dyadic classifications and relationship functioning measures. I also considered different reference groups in a series of supplemental analyses to test whether other subgroups meaningfully differed from one another.

The primary analyses involved two sets of models that varied based on informant reporting method of the relationship outcome (e.g., self-report versus interviewer-rated). That is, the *partner relationship quality* and *partner relationship stress* measures were analyzed separately. To account for partner interdependence within each of these relational constructs, I used the WITH command in Mplus to generate unbiased estimates of the standard errors (Enders & Bandalos, 2001). To adjust for interdependence of additional within-couple features, I included a series of dyad-level covariates in all structural models based on if these factors were significantly linked with maternal and paternal total PTSD symptoms. These covariates included dyad-level age, poverty, and education, as well as the committed relationship indicator (see *Measures* for description).

Results

Descriptive statistics for the overall sample

The analytic sample was comprised of 867 different-gender couples (see Table 1). On average, the individuals in these couples were in their late twenties, and the majority (75.5%) were in a committed relationship that involved marriage or cohabitation. Two-thirds of the dyads (67.8%) were comprised of individuals who both held minoritized racial and ethnic identities, with Black being the most-represented race. Nearly one-half of mothers (44.5%) reported that the index infant was their first child. When examining the highest level of education attained at the dyad level, the largest proportion of couples (37.9%) held high school degrees. Income was variable; while one-half of dyads reported living at >200% above the federal poverty line, the remaining lived below this threshold.

Bivariate relationships among primary study variables

As seen in Table 1, within-couple correlations among the primary study variables—PTSD symptoms and the two indicators of relationship functioning—were all significant, though effect sizes ranged from .25 to .68. Maternal and paternal total PTSD symptoms were positively correlated with one another; the magnitude of the association was small to moderate (r=.25). In contrast, self-reported relationship quality (r=.56) and interviewer-rated relationship stress (r=.68) were correlated with large effect sizes within couples.

Correlations considering trauma burden and PTSD symptoms for both fathers and mothers are included in Supplementary Table 1. Among fathers with available data on both past-year trauma and current PTSD symptoms (n=684), greater trauma burden was significantly correlated with more total PTSD symptoms (r=.27); a significant association was also observed between mothers' past-year trauma burden and total maternal PTSD symptoms, though the effect

size of this correlation was smaller in magnitude (n=839; r=.11). Maternal and paternal trauma history were also positively correlated (n=682; r=.24). While maternal trauma history was not significantly associated with paternal PTSD symptoms, paternal trauma history was positively correlated with maternal posttraumatic stress at a small effect size (n=684; r=.16).

LPA to identify couple subgroups

In order to determine the optimal number of latent profiles, I examined one, two, three, four, and five profile solutions; model fit indices are presented in Table 2. As the number of profiles increased, the log likelihood, AIC, BIC, and sample-sized adjusted BIC values decreased, indicating improved model fit. Entropy—an indicator of classification accuracy—was high across solutions, ranging from .92 to .94, and generally improved as the number of profiles increased. The one exception to this was with the five-profile solution, which yielded a lower entropy value than all other tested models. Maximum likelihood tests revealed that across the one, two, three, and four class solutions, each increasingly complex model provided significantly better fit than its predecessor. These findings were consistent across the two likelihood ratio test statistics, LMRT and BLRT; however, results regarding the five-profile solution were mixed across these indicators, with the LMRT suggesting poorer fit relative to the four-profile model and the BLRT indicating more improved fit (see Table 2).

As interpretability can guide model selection, I also compared the theoretical relevance of the generated means across the two, three, four, and five profile solutions (see Supplementary Table 2 for profile means and sizes across solutions). The four-profile solution, which emerged as the most favorable result based on model fit statistics and maximum likelihood tests, was also the most theoretically-consistent, in that it was comprised of two profiles characterized by couple concordance in PTSD symptoms (both low, both high) and two symptom discordant profiles

(profile where mothers are high, fathers are low; profile where mothers are low, fathers are high). However, the profile comprised of dyads where both partners reported elevated PTSD symptoms constituted only 1.3% of the sample and thus did not reach the recommended threshold of >5% of couples per group. Based on this consideration, a three-profile solution was selected as the most optimal. The emergent profiles from this solution represented one symptom concordant profile—wherein both partners in the couple reported minimal PTSD symptoms—and two symptom discordant profiles, where one partner reported substantially more PTSD symptoms than the other. I assigned labels to the profiles that captured these defining features, as follows: 1) *both low*; 2) *mother low—father high*; and 3) *mother high—father low*. These profiles respectively comprised 81%, 7%, and 12% of the sample dyads.

Sociodemographic differences across the three LPA-derived profiles

To better characterize these three empirically-derived profiles, descriptive statistics for each are presented in Supplementary Table 3. Relative to the two symptom discordant groups, a greater proportion of couples in the *both low* profile were in a committed relationship; income and education were also higher in these couples. Dyads in the *both low* subgroup were also older and more likely to be comprised of people of color than their counterparts in the symptom discordant groups. There were no significant differences in sociodemographic or relationship characteristics between the two symptom discordant groups.

Associations between LPA-derived couple profiles and relationship functioning

As seen in Table 3, models examining associations between the LPA-identified profiles and relationship functioning metrics—adjusting for dyad-level sociodemographic correlates and the relationship commitment indicator—were significant, accounting for between 12-18% of the variance in maternal and paternal relationship health. Associations were of similar magnitudes

across partners and metrics and, overall, reflected worse relational functioning among couples discordant in PTSD symptoms relative to couples where both partners reported minimal symptomatology. More specifically, relative to mothers in *both low* couples, mothers in the *mother high—father low* profile demonstrated significantly lower relationship quality (β = -0.70) and greater relationship stress (β = 0.77); the same pattern held for fathers in this profile (relationship quality: β = -0.57; relationship stress: β = 0.64). Likewise, compared to individuals in the *both low* couples, mothers and fathers in the *mother low—father high* subgroup also exhibited more adverse relationship quality (maternal β = -0.61; paternal β = -0.61) and stress (maternal β = .77; paternal β = .71). Though there were differences in the magnitude of the effect size estimates across men and women, confidence intervals were overlapping, suggesting that these differences did not reach the level of statistical significance. Analyses considering different reference groups indicated no significant differences between mothers and fathers in the symptom discordant groupings across either relationship functioning indicator (see Supplementary Table 5).

A priori couple classifications

As part of a hypothesis-driven approach, couples were classified using cut scores suggested by the literature to be approximates of clinically significant symptoms. Similar to the LPA-derived classifications, most dyads (62.5%) were captured by a *both low* group. As was the case with the latent modeling approaches, there were also two categorizations representing symptom discordance based on gender—that is, a *mother low—father high* group (13.3%) and a *mother high—father low* group (15.6%). However, unlike the LPA profiles, the *a priori* categorizations included a group of *both high* couples (8.7%), wherein both partners reported high levels of total PTSD symptoms—representing another form of symptom concordance.

Exploratory comparison of data- and hypothesis-driven couple categorizations

Approximately three-quarters of the dyads (73.5%) were categorized identically across both the LPA and *a priori* classification methods. Of those remaining, a small proportion (8.7%) were categorized as *both high* in the hypothesis-driven approach and as *both low* (*n*=9), *mother low—father high* (*n*=19), and *mother high—father low* (*n*=47) in the LPAs. The remaining dyads (17.9%) were primarily coded by the data-driven approach as *both low* and by the *a priori* methods as either *mother high—father low* (*n*=82) or *mother low—father high* (*n*=73).

Sociodemographic differences across the four a priori-determined couple profiles

Descriptive statistics for the four subgroups yielded by the hypothesis-driven approach are detailed in Supplementary Table 4. As was the case with the LPA-derived categorizations, the greatest proportion of couples in a committed relationship were in the *both low* subgroup; these couples were also more represented among the higher levels of education and were younger, on average, relative to other dyads. Couples characterized as *both low* also reported higher levels of income than those in the *mother low—father high* and *both high* subgroups.

Associations between a priori couple profiles and relationship functioning

Table 4 details associations between the *a priori* categorizations and relationship metrics; a similar amount of variance was accounted for by these models (14-19%) as those that utilized the LPA profiles. As was the case with the LPA-derived groups, relative to their counterparts in the *both low* dyads, mothers and fathers across all other symptom manifestations—including the *both high* couples—exhibited significantly greater relationship stress and lower relationship quality, even when controlling for pertinent covariates. Gender differences were again not observed, as evidenced by overlapping confidence intervals. The one exception to this general

pattern of findings is that the differences in reported relationship quality between women in the *both low* and *mother low—father high* groups did not reach statistical significance.

Analyses considering alternative reference groups revealed slightly different results than those obtained using the LPA-identified classifications. Notably, using these hypothesis-driven categorizations, significant differences were observed between the two symptom discordant groups with regard to relationship functioning (see Supplementary Table 6). Specifically, partners in discordant couples reported greater relationship quality when they were the one with low, rather than high, PTSD symptoms; this was observed for both mothers and fathers. The same pattern was observed for women, but not for men, with the relationship stress indicator. Lastly, individuals in the *both high* dyads exhibited lower relationship functioning relative to their counterparts in some, but not all, symptom discordant groups; this effect was consistent across gender and appeared to vary as a function of whomever in the dyad reported higher PTSD symptoms, with partners exhibiting better relationship functioning compared to those in *both high* couples when they were the one with low symptoms in the discordant couple. More specifically, women in the *mother low—father high* dyads and men in the *mother high—father low* couples demonstrated more optimal relationship functioning than women and men in *both high* couples; the other comparisons revealed no significant differences.

Discussion

Posttraumatic psychopathology is linked with intimate relationship difficulties (Lambert et al., 2012; Taft et al., 2013), including during the perinatal period (e.g., Thomas et al., 2021), but most research on these associations adopts an individual-level approach by considering only one partner as trauma-exposed. Examining PTSD symptomatology in couples—both through assessing trauma-related psychopathology in both members of a dyad and by considering couple-

level manifestations of posttraumatic stress—could inform targeted treatments to improve relationship functioning. In this study, my primary aim was to explore couple-level manifestations of PTSD symptomatology at a high-stress time of life: the postpartum period. Utilizing both data- and hypothesis-driven approaches, I examined if distinct subgroups of couples could be identified based on patterning of both partners' PTSD symptoms. Across both methods, I found evidence supporting different subgroups of couples, including couples characterized by concordance in minimal PTSD symptoms (*both low*) and couples discordant in symptoms (*mother low—father high* and *mother high—father low*). While most couples were identically classified across the two methods, an additional grouping—wherein partners reported concordance in high levels of PTSD symptoms (*both high*)—emerged in the hypothesis-driven, but not empirically-based, approach. In addition to evaluating potential subgroups of dyads, I also endeavored to examine associations between the identified couple-level categorizations and indicators of maternal and paternal relationship functioning. Evidence for differential associations emerged, though some variation was observed across the dyadic classifications; overall, within each categorization approach, results were relatively consistent for women and men and across the informant reporting methods.

Classifying couples according to both partners' symptoms of posttraumatic stress revealed that a range of different subgroups existed in this community-based sample of couples. Relative consistency was observed between the couple-level classifications elucidated by the latent classification approach and the groupings imposed on the data based on theoretical precedence. Indeed, a descriptive analysis examining overlap in dyad classification across the hypothesis- and data-driven methods revealed that nearly three-quarters of the sample were categorized identically across approaches. These classifications—*both low, mother low—father*

high, and *mother high—father low*—even captured the majority of the sample in the *a priori* approach, highlighting the value of latent classifications. The remaining couples in the *a priori* categorization represented dyads where partners were *both high* in symptoms, a subgroup that had been identified—along with the aforementioned groups—by the latent classification method in an empirically favorable four-profile solution. However, only 1.3% of the sample couples comprised the *both high* category in this result, rendering a three-profile solution as preferable. Given that the couples in CCHN were unselected for trauma exposure or posttraumatic psychopathology, it is likely that the restricted range and positive skew of total PTSD symptoms in this sample contributed to an inability to empirically parse as many dyads into a *both high* classification, instead relegating them to more homogenous subgroups of symptom discordance based on gender (e.g., *mother low—father high*, *mother high—father low*). In contrast to the empirical approach's classifications, which were based on continuous values observed in the present sample, the *a priori* categorizations were formed based on pre-determined cut-off scores suggestive of elevated PTSD symptomatology. These maternal and paternal cut values were drawn from a small literature that has examined the specificity and sensitivity of the PCL—the PTSD symptom measure used in this study—in a community-dwelling sample of mostly White women (Walker et al., 2002) and a healthcare-seeking sample of veteran men (Yeager et al., 2007), respectively. It is important to consider how sociodemographic differences across samples may influence the validity of these cut-offs; indeed, it may not be appropriate to directly extrapolate these scores to this sample of predominately low-income individuals, most of whom were racial and ethnic minorities. In particular, it is well-established that men who are veterans differ from their non-veteran counterparts—including regarding trauma exposure even prior to military service (Katon et al., 2015)—thereby complicating use of cut-offs validated in these

populations in research in civilians. As such, discrepancies in dyad classifications across the empirical- and hypothesis-based approaches may be due, in part, to error associated with these specific cut-points.

Nevertheless, simultaneously implementing data- and theory-driven approaches to classify couples according to both partners' PTSD symptoms can help clarify dyadic patterns, as each method has its own advantages and limitations. For example, as an empirically-based approach, latent classification methods can uncover previously undetected subgroups within datasets that may be of relevance; at the same time, these data-driven methods will always identify subgroups, regardless of their theoretical relevance, and the yielded findings should thus be interpreted cautiously and in the context of pre-existing theory (Bauer, 2021). On the other side of the coin, while hypothesis-driven approaches directly rely on theoretical precedent to form subgroups, the scores that shaped these categorizations in this study were originally validated in circumscribed and homogenous samples (e.g., men veterans) and thus potentially not as sensitive to variation in more diverse populations. Used in conjunction, these approaches validate the existence of different subgroups of dyads based on both partners' posttraumatic psychopathology, including couples characterized by concordance in minimal PTSD symptoms (*both low*) and couples discordant in symptoms (*mother high—father low* and *mother low—father high*). The only other latent classification study to model PTSD symptoms in dyads focused on mothers and children exposed to IPV, and the generated profiles largely reflected symptom concordance (Galano et al., 2020). In contrast, here I empirically identified profiles characterized by symptom discordance, as well as one subgroup of concordant couples. This latter group captured couples concordant in minimal or low PTSD symptoms, similar to dyads concordant in "no psychopathology" as identified in prior research examining assortative mating

across various psychological conditions (Low et al., 2007). Moreover, the empirical categories that emerged here also mirror those generated in a latent classification study of symptoms of depression and anxiety in couples seeking psychotherapy (e.g., both partners concordant in being low in symptoms, partners discordant in symptoms based on gender; Wu et al., 2022), as well as subgroups of dyads based on both partners' childhood trauma exposure as identified via cluster analysis (e.g., both low, medium—high, high—medium; Redd, 2017). While no subgroup comprised of individuals concordant in high PTSD symptomatology emerged in the empirical approach, this theory-driven grouping reflects categorizations observed in other psychopathology concordance literature (e.g., Wu et al., 2022) and embodies the principle of assortative mating. It is also possible that selection biases may have precluded the enrollment of many individuals high in PTSD symptoms, thus limiting ability of the data-driven to identify *both high* dyads. As one pertinent example, women enrolled in CCHN had to provide consent for their partners to join the study, and it may be that the women who did consent to this were more likely to be partnered with men with low in PTSD symptoms—thereby resulting in fewer fathers with elevated PTSD symptomatology.

Across both categorization methods, the majority of couples were classified as *both low*—in that both partners endorsed relatively minimal PTSD symptoms. This aligns with research in the general population that demonstrates that while trauma exposure is common, only a minority of survivors go on to develop threshold PTSD (Kessler et al., 1995). Nevertheless, the large proportion of couples where both partners were low in PTSD symptomatology is particularly notable given the high rates of past-year trauma exposure in this sample. Minimal endorsement of posttraumatic psychopathology symptoms likely speaks to the individual- and community-level resilience of CCHN's participants, a topic that has been explored in other

research in this sample (e.g., Ramey et al., 2015). It is also important to note that the *both low* label in this study was imposed on these dyads based on the yielded maternal and paternal PTSD scores relative to those in the other identified subgroups; indeed, though these PTSD symptom levels are low when compared to others in the sample, these average symptom scores reflect endorsement of some, rather than no, PTSD symptoms. This may be a function of the more elevated rates of recent trauma exposure in this sample.

Findings examining associations between these couple-level PTSD manifestations and relationship functioning emphasized the importance of a dyadic conceptualization of posttraumatic stress. The pattern of associations yielded across the data- and hypothesis-driven approaches were largely, though not entirely, complementary. Collectively, both methods' results illuminate the value of considering couple-level manifestations of posttraumatic stress when examining maternal and paternal relationship functioning during the postpartum period. Indeed, associations between a dyadic indicator of PTSD symptomatology and individual-level relationship functioning were born out across the analytic approaches and remained significant when adjusting for pertinent covariates—emphasizing the role of PTSD above and beyond relationship commitment and financial strain, among other factors linked with intimate relationship functioning. Moreover, couple-level PTSD was equally important for both members of these different-gender couples; overlapping confidence intervals revealed no gender differences in relationship functioning across informant methods, supporting the gender similarities hypothesis.

Across the two classification methods, the most consistent finding was that relative to their counterparts in dyads *both low* in symptoms, men and women in couples experiencing any form of posttraumatic psychopathology exhibited greater interviewer-rated relationship stress.

Similar patterns were observed with regard to the self-report indicator of relationship quality, again highlighting that both mothers and fathers in couples characterized by posttraumatic psychopathology displayed less optimal relationship functioning than their counterparts with minimal symptomatology. However, there was one notable divergence across the data- and hypothesis-driven approaches in these analyses; that is, women classified into *mother low—father high* couples by the *a priori* method did not report significant differences in relationship quality relative to their *both low* counterparts, whereas mothers categorized as such by the latent profiles did. This discrepancy was surprising, particularly since associations were observed with the objective indicator of relationship functioning. Potential methodological explanations center on the diverse classifications of dyads across the two methods; for example, a fair number of couples (*n*=73) were categorized as *mother low—father high* in the *a priori* approach and as *both low* by the latent profiles. Adopting the cut-off score from the literature may have artificially inflated the size of the theory-driven grouping and subsequently masked associations detectable by a data-driven approach that was more sensitive to this sample's range of PTSD symptoms.

Some other important differences between the two classification methods also emerged. Using the LPA-derived groupings, couples discordant in PTSD symptomatology—that is, the *mother high—father low* and the *mother low—father high* couples—did not differ from one another with regard to relationship quality or stress. In other words, the gender of the partner with elevated PTSD symptoms was not differentially associated with the relationship functioning measures in women or men. This pattern was not observed with the *a priori* categorizations, wherein there was graded discrimination between these two subgroups across both relationship indicators and partners. Indeed, using the theory-driven groupings, individuals who were low in symptoms when their partners were high (e.g., women in the *mother low—father high* dyads)

exhibited more optimal relationship functioning than their counterparts in the other symptom discordant group with elevated symptoms (e.g., women in the *mother high—father low* groupings). This pattern held for both women and men and was consistent across informant methods, with one exception: fathers in the *mother low—father high* dyads did not differ from those in the *mother high—father low* subgroup on relationship stress. While the effect in question was not statistically significant, it did trend in the theorized direction, such that fathers in the *mother low—father high* dyads exhibited greater stress, as would be expected given the presence of elevated paternal psychopathology.

Another difference between the two classification methods was related to the *both high* subgroup based on the theory-driven approach, wherein couples were concordant in elevated PTSD symptoms. Indeed, relative to their counterparts in the *both high* dyads, neither men nor women in symptom discordant couples benefitted from having a partner low in symptoms. That is, women in the *mother high—father low* group and men in the *mother low—father high* group exhibited similar relationship functioning as their counterparts in the *both high* couples, and this was consistent across both subjective and objective measures of relationship functioning. It may be that in the presence of any posttraumatic psychopathology at the couple-level, the relationship health of individuals is more strongly influenced by their own, rather than their partner's, trauma-related symptoms. These individuals' high levels of PTSD symptomatology may then prevent them from responding to or engaging with their partners, whom would be arguably less affected by psychopathology.

Despite some divergences in results yielded across the classification methods, findings collectively complement and extend prior work considering trauma and posttraumatic distress in couples. For instance, the finding that couples characterized by any elevated PTSD symptoms—

whether endorsed by one or by both partners—experience lower relationship functioning than couples where both partners are low in symptoms is consistent with previous research considering single trauma, dual trauma, and non-trauma-exposed couples (Nelson & Wampler, 2000). Moreover, the finding that both partners' PTSD symptoms are relevant to relationship functioning is consistent with some (though not at all; see Ayers et al., 2011) prior work conducted in couples during the postpartum period (Fredman et al., 2017). However, it is important to note that the current study utilized a dyad-centered approach—where the predictor represented couple-level patterning of PTSD symptomatology—rather than the individual-level perspective adopted by prior work in perinatal populations, in which both partners' PTSD symptoms are considered as individual predictors. These different approaches—where the level of analysis varies—complicate direct comparisons of findings, as they answer slightly different research questions. Further, unlike these perinatal-specific studies and most other research on PTSD and relationship metrics (for a review, see Campbell & Renshaw, 2018; for a call to action for relationship science researchers to use more objective measures, see Joel et al., 2020), the present work includes both subjective and objective measures of relationship functioning; indeed, I observed convergence across both the self-report and interviewer-rated indicators, thereby minimizing concerns about shared method variance and increasing confidence in findings. Finally, whereas the limited work in this area has primarily considered these processes in homogenous samples of mostly White and military-affiliated individuals, this study examined these research questions in a sample of predominately low-income, racial and ethnic minority couples during the postpartum period—a vulnerable population during a high-stress time of life.

While the study design precludes testing potential mechanisms explaining why certain individuals were partnered with others either concordant or discordant from them in PTSD

symptoms, I offer some hypotheses. Most couples in this study were characterized by both individuals reporting minimal PTSD symptoms, regardless of the categorization approach. This patterning is consistent with concordance of "non-psychopathology" in other studies of community-based couples (Low et al., 2007), as well as likely reflects low base rates of elevated PTSD symptoms, as is typical in the general population. Indeed, although trauma exposure is common, it is estimated that less than 8% of individuals meet diagnostic criteria for lifetime PTSD (Kessler et al., 1995); thus, concordance in minimal symptomatology is to be expected, particularly in non-clinical samples. Moreover, aligned with the notion of assortative mating, trauma-exposed individuals may have been drawn to other trauma-exposed individuals based on similar manifestations of posttraumatic psychopathology, even if both partners' symptoms were relatively minimal. Indeed, in this study, both trauma burden and posttraumatic stress symptoms were significantly correlated within couples within the broader sample, with small-to-moderate effect sizes; these within-couple correlations of PTSD symptoms were also aligned with values obtained in other studies on couple similarity in psychopathology (e.g., .20 to .30; for a review, see Luo et al., 2017). Importantly, the trauma exposure measure was anchored only in the past year, which may explain the small effects observed; moreover, the assessment was not comprehensive, capturing only a few potential exposures. Undoubtedly, individuals assort for a variety of both genetically determined (e.g., height) and socially determined (e.g., religion) traits (Dubuis-Stadelmann et al., 2001; Luo et al., 2017; Merikangas, 1982) beyond posttraumatic psychopathology or the vulnerabilities to negative affect that have been shown to underlie risk for PTSD; thus, couple similarity in unassessed third variables may also explain these groupings.

It is also possible that individuals with elevated posttraumatic stress may have influenced their partners' manifestations of traumatic stress following their partnership, a phenomenon

known as secondary traumatic stress (Figley, 1995). Within this framework, it could be that being partnered with someone with elevated posttraumatic symptomatology may increase an individual's risk of exhibiting traumatic stress symptoms even if not directly exposed to trauma or elevate their odds of developing PTSD following later trauma exposure; it may also be that being romantically involved with someone with PTSD makes it more difficult to recover from trauma-related psychopathology that predates the relationship. Moreover, it is also possible that shared traumatic experiences that occurred in the context of the couple relationship (e.g., traumatic birth of the index child; both individuals were in the same car accident; see McLeod, 1995) precipitated posttraumatic stress in one or both members of the couple. Without more granular data on both partners' lifetime trauma exposure and timeline around the initiation of the current relationship and posttraumatic stress symptomatology, questions around the mechanisms of how these individuals partnered with one another remain unanswerable with this sample.

Irrespective of how these individuals partnered with one another, several theoretically plausible mechanisms may explain why relationship functioning varies by couple-level manifestations of PTSD. The cognitive and interpersonal difficulties associated with posttraumatic distress may compromise survivors' abilities to maintain close and intimate relationships. Indeed, interpersonal detachment, restricted affect, and heightened irritability are all common PTSD symptoms that can interfere with an individual's ability to engage in the relational processes known to promote intimacy and broader relationship health (e.g., communication, conflict resolution, provision of socioemotional support). As proposed by the CATS model, these PTSD symptoms in one partner can then trigger related or other responses in the other partner, which could then function to increase relationship discord—thus facilitating a

negative feedback loop that maintains both posttraumatic distress and relationship dysfunction at the both couple- and individual- levels.

Behavioral issues may also play a role, as individuals may inadvertently act in ways that maintain or amplify their own and/or their partner's trauma-related symptoms—with downstream effects on the intimate relationship. A prime example is partner accommodation—defined as behaviors performed by an intimate partner on behalf of a survivor that are intended to manage or reduce the survivor's PTSD symptoms (Campbell & Renshaw, 2018). For example, if Partner A is a survivor of a mall gun shooting and afraid to return to retail outlets following trauma, Partner B may complete the family's holiday shopping. While on the surface, this act may be in service of reducing Partner A's distress, Partner B's behavior may actually maintain Partner A's PTSD symptoms over time by limiting opportunities for them to learn that shopping is safe. It is also conceivable that some instances of accommodation may be less specific to one partner's trauma, as in the above example, and thematically relevant to both trauma-exposed individuals in a dyad. For example, couples may avoid potentially enjoyable settings or situations (e.g., going on a date to the movies or to a restaurant) that also have the potential to provoke anxiety due to uncertainty in one or both of the trauma-exposed partners. As another example, couples may also limit discussions of emotionally charged topics in the relationship (e.g., financial planning) in order to avoid provoking trauma-related negative affect (as explored in qualitative interviews with dual trauma couples in Nelson-Goff et al., 2014). While well-intentioned, these behaviors can function to maintain posttraumatic distress in both members of the dyad, as well as limit opportunities to build intimacy and relational health. Processes such as partner accommodation may explain why, in this study, individuals in the *both high* couples did not benefit from having a partner low in PTSD symptoms; it may be that both partners engaged

in accommodation behaviors, to some extent, to manage posttraumatic psychopathology which, in turn, prohibited greater relationship development.

Importantly, common experiences of trauma and posttraumatic psychopathology may also be a source of resiliency for some couples, particularly when at least one partner endorses relatively few PTSD symptoms. Indeed, as has been proposed in the childbirth-induced PTSD literature (Delicate et al., 2017), some partner relationships can also be strengthened following trauma. For example, couples who experienced mutual trauma related to the birthing experience—such as miscarriage, stillbirth, or postpartum hemorrhage—may be able to support one another and co-manage related traumatic stress, thus preserving or even enhancing their relationship functioning. Even dyads wherein couples have experienced different traumas may benefit from shared understanding of trauma's psychological impact, as these individuals may be particularly empathetic to their partner's experiences and potentially more responsive to and engaged in the couple relationship. Other individuals may find their partner's PTSD symptoms overwhelming due to their own unresolved trauma and thus behave in ways that increase conflict in the relationship (e.g., make unreasonable demands of partner, engage in the silent treatment when emotionally provoked). These are merely some of the potential clinical contexts which could explain the discrete couple-level PTSD typologies—including PTSD symptom discordance—that emerged in this study. Better understanding of the factors that lead to and maintain these dyadic patterns of posttraumatic psychopathology is an important avenue of future research. Indeed, future work should strive to longitudinally follow trauma-exposed couples and assess these candidate mechanisms in order to disentangle *how* dyad-level classifications of PTSD influence relationship distress—or vice versa—over time.

The findings from this study—namely, that couples can be categorized by both partners' PTSD symptoms and that these dyadic or couple-level classifications are differentially linked with individuals' relationship functioning—may have clinical implications for perinatal health. Indeed, the co-occurrence of posttraumatic stress and relationship distress may be especially pertinent for perinatal populations, for whom the prevalence of mental health conditions is high (Howard & Khalifeh, 2020), and the perinatal period—a time during which women have frequent contact with the healthcare system—may be an important window of opportunity during which to engage couples in intervention, particularly among those who might not otherwise seek or access care. The discrete typologies of couple-level PTSD manifestations identified in this study may be helpful heuristics in clinical settings, as assessing and attuning to trauma history and potential posttraumatic distress in both women and their partners during the perinatal period could inform providers' treatment recommendations. For example, most extant PTSD interventions—such as Prolonged Exposure and Cognitive Processing Therapy—are delivered at the individual level, though some clinicians do elect to involve romantic partners occasionally throughout care. However, the results of this study compel systematic consideration of dyadic approaches to PTSD treatment. One notable exception to the more traditional individual-level approach to trauma treatment is Cognitive Behavioral Conjoint Therapy for PTSD (Monson & Fredman, 2012), which is delivered to couples where one partner is diagnosed with PTSD; to my knowledge, no research has yet assessed the intervention among dual trauma couples where one or both partners is experiencing posttraumatic psychopathology. Given the role couple-level conceptualizations of traumatic stress can play in relationship functioning, it may be warranted to examine the efficacy of this and related dyadic interventions in these couples.

To my knowledge, this is the first study to examine posttraumatic stress symptoms in couples in a dyadic LPA, the findings from which were largely—though not entirely—consistent with a theory-driven approach. Adopting these two approaches in tandem illuminated the value of considering multiple analytic perspectives, particularly when research substantiating one approach over another is lacking. Another important methodological strength of this study is the multi-modal, multi-informant assessment of relationship functioning, as self-report measures may potentially inflate associations due to shared method variance. Indeed, couples in this study often scored high on both self-reported symptom- and relationship-related distress measures, a common problem in the literature on psychopathology in couples (Campbell & Renshaw, 2018); utilizing an objective measure of relationship stress bolsters confidence in the obtained results and rule out concerns that findings reflected mono-method bias. Additionally, most research on psychopathology in perinatal populations has examined more advantaged populations, such as White, highly-educated, middle-to-upper-middle class women; as aforementioned, less is known about how perinatal mental health may function in more sociodemographically diverse samples, including fathers. Indeed, scholars have called for greater representation of fathers in research on perinatal psychopathology (Fisher et al., 2021), and research that assesses paternal posttraumatic stress symptoms during the perinatal period is particularly lacking. As an example, a recent systematic review of childbirth-related PTSD—the most frequently studied form of trauma-related psychopathology in perinatal populations—identified only four studies that focused on men (Heynes et al., 2022); moreover, all included work assessed posttraumatic stress as anchored to the delivery experience, which may or may not function as the index trauma upon which paternal PTSD during the perinatal period is anchored. Without more research on the prevalence and manifestations of paternal posttraumatic psychopathology, the field will remain limited in its

understanding of the role both fathers and different-gender couples play in relationship health during this time of life.

In addition to these important contributions, this study has limitations. As a secondary data analysis, data on additional variables of interest—including relationship length, as well as a systematic assessment of trauma-related factors (e.g., lifetime exposure history, timing of exposures)—were not available. By virtue of when the PTSD and relationship functioning assessments were administered in the larger parent study, the present design is cross-sectional and precludes conclusions regarding directionality of associations. Moreover, the couples in this study were connected via recent birth of a baby and may differ from other types of partnerships (e.g., married but without kids). It is also unknown whether all individuals in this study were truly trauma-exposed, and as the PTSD measure was not anchored to an index event, it may be that the symptom assessment is capturing more generalized distress rather than posttraumatic psychopathology. However, analyses considering past-year trauma burden found a significant and positive correlation between a count of select types of potentially traumatic experiences and PTSD symptoms in both women and men—lending some support to the validity of this PTSD measure. Nevertheless, future research examining couple-level posttraumatic psychopathology should be conducted in samples explicitly selected for trauma exposure.

As a final methodological note, this study leveraged dyadic data to elucidate the existence of couple subgroups and to examine relational correlates of subgroup membership. While applying latent classification methods to dyadic data can answer important questions about *who* comprises distinct subgroups of dyads in a population, it may not be appropriate for all research questions involving couples. For example, this approach cannot directly examine whether maternal or paternal characteristics exert more influence on an outcome in members of a couple;

for these types of questions, a variable-centered approach such as the APIM may be considered (Kenny et al., 2006). Other dyadic analytic methods include the common fate and dyadic score models, which focus on couple-level processes by examining shared constructs (e.g., mutual couple identity) and contrasts (e.g., difference scores across partners), respectively (Iida, Seidman, & Shrout, 2018). Advances in dyadic data analysis have grown rapidly in recent years, and scholars are advised to consider which statistical models may best capture the theoretical processes of interest (Iida et al., 2018). Dependent on the research question, future studies on couple-level PTSD may benefit from different analytic approaches than those adopted herein.

Conclusions

Using both data- and hypothesis-driven approaches, distinct subgroups of couples based on both partners' PTSD symptoms—including couples characterized by symptom concordance (*both low*) and discordance (*mother low—father high*, *mother high—father low*)—were elucidated in this sample of different-gender couples during the postpartum period. These couple-level manifestations of posttraumatic psychopathology were relevant to both maternal and paternal relationship functioning, with partners in couples experiencing elevated PTSD symptoms generally demonstrating more adverse relationship health across both subjective and objective indicators. Considering couple-level posttraumatic stress may hold clinical promise for improving partner relationship health during this transitory time.

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Table 1. Descriptive Statistics for Overall Sample (*N* = 867 Couples)

	Mothers	Fathers	Within-Couple Correlation
Individual-level characteristics			
Age	26.39 (5.70)	29.23 (7.10)	*r* = .728***
Race/ethnicity			
White	30.2 (262)	26.8 (232)	
Black	44.5 (386)	46.4 (402)	
Latinx	25.3 (219)	24.0 (208)	
Other	--	2.9 (25)	
Education			
< HS graduate	16.3 (141)	21.0 (182)	
HS graduate	38.8 (336)	39.9 (346)	
Some college	24.8 (215)	14.9 (129)	
College graduate or more	19.6 (170)	16.8 (146)	
Other/no information	0.6 (5)	7.4 (64)	
Poverty			
≤100% FPL	38.8 (336)	30.9 (257)	
100-200% FPL	27.1 (235)	21.4 (178)	
>200% FPL	34.1 (296)	47.8 (398)	
First baby	44.5 (386)	--	
Past-year trauma burden	0.82 (0.96)	1.07 (1.20)	*r* = .243***
Total PTSD symptom severity	26.02 (9.79)	25.69 (9.93)	*r* = .253***
Observed range	17-79	17-72	
Relationship quality	120.59 (16.57)	122.81 (15.45)	*r* = .558**
Observed range	48-151	47-152	
Relationship stress	1.76 (0.82)	1.72 (0.76)	*r* = .681**
Observed range	1-5	1-5	
Couple-level characteristics			
Average age	27.83 (5.96)		
Minority racial and ethnic couple	67.8 (588)		
Committed relationship	75.5 (655)		
Highest level of education			
< HS graduate	10.5 (91)		
HS graduate	37.9 (329)		
Some college	28.0 (243)		
College graduate or more	23.4 (203)		
Highest level of income			
≤100% FPL	23.4 (203)		
100-200% FPL	25.1 (218)		
>200% FPL	51.4 (446)		

****p*<.001 ***p*<.01 **p*<.05*

Table 2. Results from Dyadic Latent Profile Analyses

LPA Model	Class sizes	Entropy	Log likelihood	AIC	BIC	Adjusted BIC	LMRT, *p*-value	BLRT, *p*-value
1-class	867		-6426.990	12861.980	12881.040	12868.337	—	—
2-class	772, 95	.929	-6231.778	12477.555	12510.911	12488.680	372.091, $p<.001$	-6426.990, $p<.0001$
3-class	706, 61, 100	.932	-6111.063	12242.127	12289.777	12258.020	230.091, $p=.005$	-6231.778, $p<.0001$
4-class	11, 100, 691, 65	.942	-6050.330	12126.661	12188.606	12147.322	115.762, $p=.027$	-6111.063, $p<.001$
5-class	626, 33, 77, 102, 29	.920	-5997.766	12027.531	12103.772	12052.960	100.193, $p=.194$	-6050.330, $p<.001$

Table 3. Associations Between LPA-derived Couple-level PTSD Manifestations and Relationship Functioning

	Relationship quality			Relationship stress		
	β	95% CI	*p*	β	95% CI	*p*
Mothers		R^2 = .12			R^2 = .18	
Profile: Mother high—father low	-0.70	(-1.00, -0.40)	**<.001**	0.77	(0.52, 1.03)	**<.001**
Profile: Mother low—father high	-0.61	(-0.96, -0.25)	**.001**	0.71	(0.44, 0.99)	**<.001**
Married and/or cohabitating	0.32	(0.05, 0.59)	**.019**	-0.42	(-0.61, -0.23)	**<.001**
Dyad-level age	0.00	(-0.02, 0.02)	.949	0.00	(-0.02, 0.01)	.870
Dyad-level income						
≤100% FPL	-0.12	(-0.35, 0.12)	.341	0.19	(-0.01, 0.38)	.057
100-200% FPL	0.07	(-0.14, 0.28)	.525	-0.04	(-0.21, 0.12)	.601
>200% FPL		Reference Group			Reference Group	
Dyad-level education						
< HS graduate	0.30	(0.01, 0.59)	**.043**	0.16	(-0.11, 0.44)	.241
HS graduate	-0.16	(-0.40, 0.07)	.179	0.30	(0.10, 0.49)	**.003**
Some college	-0.12	(-0.35, 0.12)	.332	0.23	(0.04, 0.42)	.016
College graduate or more		Reference Group			Reference Group	
Fathers		R^2 = .13			R^2 = .18	
Profile: Mother high—father low	-0.57	(-0.84, -0.31)	**<.001**	0.64	(0.39, 0.90)	**<.001**
Profile: Mother low—father high	-0.93	(-1.25, -0.60)	**<.001**	0.91	(0.58, 1.23)	**<.001**
Married and/or cohabitating	0.44	(0.19, 0.69)	**.001**	-0.40	(-0.60, -0.20)	**<.001**
Dyad-level age	0.01	(-0.01, 0.02)	.368	0.00	(-0.01, 0.01)	.915
Dyad-level income						
≤100% FPL	0.04	(-0.18, 0.27)	.704	0.31	(0.11, 0.51)	**.003**
100-200% FPL	0.16	(-0.05, 0.37)	.128	0.04	(-0.13, 0.21)	.649
>200% FPL		Reference Group			Reference Group	
Dyad-level education						
< HS graduate	0.41	(0.09, 0.74)	**.012**	0.15	(-0.16, 0.46)	.330
HS graduate	0.10	(-0.16, 0.36)	.441	0.16	(-0.04, 0.35)	.119
Some college	0.17	(-0.06, 0.40)	.142	0.17	(-0.03, 0.37)	.103
College graduate or more		Reference Group			Reference Group	

Note: The reference group is *both low*.

Table 4. Associations Between *A Priori*-determined Couple-level PTSD Manifestations and Relationship Functioning

	Relationship quality			Relationship stress		
	β	95% CI	*p*	β	95% CI	*p*
Mothers		R^2 = .14			R^2 = .19	
Profile: Mother high—father low	-0.70	(-0.94, -0.46)	**<.001**	0.63	(0.43, 0.83)	**<.001**
Profile: Mother low—father high	-0.21	(-0.47, 0.06)	.126	0.33	(0.13, 0.54)	**.001**
Profile: Both high	-0.71	(-1.06, -0.37)	**<.001**	0.89	(0.61, 1.18)	**<.001**
Married and/or cohabitating	0.34	(0.09, 0.60)	**.009**	-0.43	(-0.62, -0.23)	**<.001**
Dyad-level age	0.00	(-0.02, 0.01)	.597	0.00	(-0.01, 0.02)	.754
Dyad-level income						
≤100% FPL	-0.14	(-0.38, 0.09)	.230	0.19	(-0.01, 0.38)	.056
100-200% FPL	0.08	(-0.13, 0.28)	.468	0.28	(-0.22, 0.11)	.528
>200% FPL		Reference Group			Reference Group	
Dyad-level education						
< HS graduate	0.27	(-0.03, 0.56)	.075	0.20	(-0.08, 0.47)	.156
HS graduate	-0.15	(-0.39, 0.09)	.209	0.28	(0.08, 0.48)	**.005**
Some college	-0.13	(-0.36, 0.10)	.284	0.23	(0.05, 0.42)	**.013**
College graduate or more		Reference Group			Reference Group	
Fathers		R^2 = .14			R^2 = .19	
Profile: Mother high—father low	-0.27	(-0.49, -0.04)	**.021**	0.47	(0.27, 0.67)	**<.001**
Profile: Mother low—father high	-0.68	(-0.92, -0.43)	**<.001**	0.64	(0.42, 0.87)	**<.001**
Profile: Both high	-0.85	(-1.15, -0.56)	**<.001**	0.89	(0.59, 1.20)	**<.001**
Married and/or cohabitating	0.46	(0.22, 0.70)	**<.001**	-0.41	(-0.62, -0.20)	**<.001**
Dyad-level age	0.01	(-0.01, 0.02)	.508	0.00	(-0.01, 0.02)	.755
Dyad-level income						
≤100% FPL	0.00	(-0.22, 0.22)	.996	0.32	(0.12, 0.52)	**.002**
100-200% FPL	0.13	(-0.08, 0.34)	.221	0.04	(-0.13, 0.21)	.623
>200% FPL		Reference Group				
Dyad-level education						
< HS graduate	0.43	(0.11, 0.75)	**.009**	0.15	(-0.14, 0.45)	.315
HS graduate	0.14	(-0.12, 0.39)	.305	0.12	(-0.08, 0.32)	.223
Some college	0.18	(-0.05, 0.41)	.118	0.16	(-0.04, 0.36)	.108
College graduate or more		Reference Group			Reference Group	

Note: The reference group is *both low*.

Supplementary Table 1. Bivariate Associations Between Primary Study Variables

	1.	2.	3.	4.	5.	6.	7.	8.
1. Maternal trauma burden	—							
2. Paternal trauma burden	.243***	—						
3. Maternal PTSD symptoms	.111***	.164***	—					
4. Paternal PTSD symptoms	.064	.266***	.253***	—				
5. Maternal relationship quality	-.042	-.112**	-.314***	-.174***	—			
6. Paternal relationship quality	-.96*	-.160***	-.241***	-.386***	.558***	—		
7. Maternal relationship stress	.056	.131***	.361***	.275***	-.587***	-.439***	—	
8. Paternal relationship stress	.068	.164***	.307***	.373***	-.432***	-.547***	.681***	—

****p<.001 **p<.01 *p<.05*

Supplementary Table 2. Maternal and Paternal PTSD Symptoms Across Different Profile Solutions

	% (*N*)	Maternal PTSD symptoms M(SE)	Paternal PTSD symptoms M(SE)
One-profile solution			
Class 1	100.0 (867)	26.02 (0.33)	25.69 (0.34)
Two-profile solution			
Class 1	88.0 (772)	25.13 (0.36)	22.83 (0.31)
Class 2	12.0 (95)	32.76 (1.60)	47.49 (1.82)
Three-profile solution			
Class 1	81.0 (706)	22.99 (0.31)	22.85 (0.28)
Class 2	7.0 (61)	26.36 (1.30)	50.58 (1.89)
Class 3	12.0 (100)	47.70 (1.51)	30.70 (1.63)
Four-profile solution			
Class 1	1.3 (11)	53.13 (4.13)	54.29 (3.78)
Class 2	11.4 (100)	45.89 (1.28)	27.58 (1.05)
Class 3	79.7 (691)	22.76 (0.25)	22.61 (0.31)
Class 4	7.5 (65)	25.22 (0.89)	48.80 (2.30)
Five-profile solution			
Class 1	72.2 (626)	22.62 (0.28)	21.42 (0.23)
Class 2	3.8 (33)	25.51 (1.14)	56.48 (1.70)
Class 3	8.8 (77)	46.01 (1.86)	24.53 (1.29)
Class 4	11.8 (102)	25.14 (1.01)	36.93 (1.12)
Class 5	3.3 (29)	32.49 (3.30)	21.14 (1.88)

Supplementary Table 3. Couple-level Sociodemographic Characteristics for LPA-derived Profiles

	All Couples 100.0 (867) % (N) or M (SD)	**Both Low 81.0 (706) % (n) or M (SD)**	**Mother Low—Father High 7.0 (61) % (n) or M (SD)**	**Mother High—Father Low 12.0 (100) % (n) or M (SD)**	**x^2 or F**
Age[a]	27.78 (5.96)	28.12 (5.91)	25.41 (5.51)	26.82 (6.17)	7.41***
Minority racial and ethnic couple[b]	67.8 (588)	66.0 (466)	73.8 (45)	77.0 (77)	5.92
Committed relationship[a,b]	77.4 (655)	80.8 (559)	57.9 (33)	64.9 (63)	25.53***
Highest level of education[a,b]					30.89***
< HS graduate	10.5 (91)	9.3 (66)	14.8 (9)	16.0 (16)	
HS graduate	38.0 (329)	37.0 (261)	44.3 (27)	41.0 (41)	
Some college	28.1 (243)	26.5 (187)	34.4 (21)	35.0 (35)	
College graduate or more	23.4 (203)	27.1 (191)	6.6 (4)	8.0 (8)	
Highest level of income[a.b]					15.81**
≤100% FPL	23.4 (203)	21.1 (149)	37.7 (23)	31.0 (31)	
100-200% FPL	25.1 (218)	24.6 (174)	26.2 (16)	28.0 (28)	
>200% FPL	51.4 (446)	54.2 (383)	36.1 (22)	11.5 (100)	

****p<.001 **p<.01 *p<.05*

[a]Significant difference between *both low* and *mother low—father high* at $p<.05$

[b]Significant difference between *both low* and *mother high—father low* at $p<.05$

[c]Significant difference between *mother low—father high* and *mother high—father low* at $p<.05$

Supplementary Table 4. Couple-level Sociodemographic Characteristics for *A Priori*-determined Categorizations

	All Couples *N*=867 % (N) or M (SD)	**Both Low 62.5 (542) % (n) or M (SD)**	**Mother Low—Father High 13.3 (115) % (n) or M (SD)**	**Mother High—Father Low 15.6 (135) % (n) or M (SD)**	**Both High 8.7 (75) % (n) or M (SD)**	**x^2 or F**
Age[a,b,f]	27.78 (5.96)	28.67 (6.01)	26.22 (5.32)	26.52 (5.59)	26.06 (6.03)	11.07***
Minority racial and ethnic couple[b]	67.8 (588)	63.3 (343)	70.4 (81)	90.0 (108)	74.7 (56)	16.26***
Committed relationship[a,b,d,e,f]	75.5 (655)	82.7 (439)	71.6 (78)	73.9 (99)	54.2 (39)	33.76***
Highest level of education[a,b,f]						48.87***
< HS graduate	10.5 (91)	8.5 (47)	17.4 (20)	14.1 (19)	8.0 (6)	
HS graduate	38.0 (329)	35.1 (190)	40.9 (47)	42.2 (57)	46.7 (35)	
Some college	28.1 (243)	25.7 (139)	29.6 (34)	31.9 (43)	36.0 (27)	
College graduate or more	23.4 (203)	30.7 (166)	12.2 (14)	11.9 (16)	9.3 (7)	
Highest level of income[b,f]						18.80*
≤100% FPL	23.4 (203)	19.6 (106)	27.8 (32)	31.1 (42)	20.7 (23)	
100-200% FPL	25.1 (218)	23.9 (129)	26.1 (30)	28.9 (39)	26.7 (20)	
>200% FPL	51.4 (446)	56.6 (307)	46.1 (53)	40.0 (54)	42.7 (32)	

****p<.001* ***p*<.01 **p<.05*

[a]Significant difference between *both low* and *mother low—father high* at *p*<.05

[b]Significant difference between *both low* and *mother high—father low* at *p*<.05

[c]Significant difference between *mother low—father high* and *mother high—father low* at *p*<.05

[d]Significant difference between *mother low—father high* and *both high* at *p*<.05

[e]Significant difference between *mother high—father low* and *both high* at *p*<.05

[f]Significant difference between *both low* and *both high* at *p*<.05

Supplementary Table 5. Associations Between LPA-derived Couple-level PTSD Manifestations and Relationship Functioning, Presented for Different Reference Groups

	Relationship quality			Relationship stress		
	β	95% CI	*p*	β	95% CI	*p*
Reference group: Both low						
Mothers						
Profile: Mother high—father low	-0.70	(-1.00, -0.40)	**<.001**	0.77	(0.52, 1.03)	**<.001**
Profile: Mother low—father high	-0.61	(-0.96, -0.25)	**.001**	0.71	(0.44, 0.99)	**<.001**
Fathers						
Profile: Mother high—father low	-0.57	(-0.84, -0.31)	**<.001**	0.64	(0.39, 0.90)	**<.001**
Profile: Mother low—father high	-0.93	(-1.25, -0.60)	**<.001**	0.91	(0.58, 1.23)	**<.001**
Reference group: Mother high—father low						
Mothers						
Profile: Mother low—father high	0.10	(-0.36, 0.47)	.678	-0.06	(-0.44, 0.32)	.764
Fathers						
Profile: Mother low—father high	-0.35	(-0.75, 0.02)	.082	0.27	(-0.15, 0.68)	.160

Note: Models are adjusted for dyad-level relationship commitment, age, poverty, and education.

Supplementary Table 6. Associations Between *A Priori*-determined Couple-level PTSD Manifestations and Relationship Functioning, Presented for Different Reference Groups

	Relationship quality			Relationship stress		
	β	95% CI	*p*	β	95% CI	*p*
Reference group: Both low						
Mothers						
Profile: Mother high—father low	-0.70	(-0.94, -0.46)	**<.001**	0.63	(0.43, 0.83)	**<.001**
Profile: Mother low—father high	-0.21	(-0.47, 0.06)	.126	0.33	(0.13, 0.54)	**.001**
Profile: Both high	-0.71	(-1.06, -0.37)	**<.001**	0.89	(0.61, 1.18)	**<.001**
Fathers						
Profile: Mother high—father low	-0.27	(-0.49, -0.04)	**.021**	0.47	(0.27, 0.67)	**<.001**
Profile: Mother low—father high	-0.68	(-0.92, -0.43)	**<.001**	0.64	(0.42, 0.87)	**<.001**
Profile: Both high	-0.85	(-1.15, -0.56)	**<.001**	0.89	(0.59, 1.20)	**<.001**
Reference group: Both high						
Mothers						
Profile: Mother high—father low	0.02	(-0.39, 0.42)	.942	-0.26	(-0.62, 0.09)	.143
Profile: Mother low—father high	0.51	(0.09, 0.93)	**.017**	-0.56	(-0.90, -0.22)	**.001**
Fathers						
Profile: Mother high—father low	0.59	(0.25, 0.93)	**.001**	-0.42	(-0.79, -0.06)	**.023**
Profile: Mother low—father high	0.18	(-0.18, 0.53)	.332	-0.25	(-0.63, 0.13)	.196
Reference group: Mother high—father low						
Mothers						
Profile: Mother low—father high	0.49	(0.16, 0.83)	**.004**	-0.30	(-0.57, -0.03)	**.031**
Fathers						
Profile: Mother low—father high	-0.41	(-0.71, -0.11)	**.007**	0.17	(-0.12, 0.46)	.245

Note: Models are adjusted for dyad-level relationship commitment, age, poverty, and education.

Study 3

Dimensions of posttraumatic stress, menopause and aging-related symptoms, and sexual functioning among midlife women veterans

Abstract

Purpose: Posttraumatic stress disorder (PTSD) is linked with menopause and aging-related symptoms (e.g., vasomotor, urinary) and their functional sequelae (e.g., sexual difficulties) in women. However, PTSD is a heterogeneous disorder comprised of several distinct symptom dimensions, and less is known about which aspects of trauma-related distress may be most relevant to the health of midlife women. Studying PTSD dimensions in the context of menopause-related health may shed light on potential mechanisms driving associations.

Methods: Using confirmatory factor analyses, I evaluated five structural models of PTSD in a sample of predominately postmenopausal women veterans (ages 45-64; *N*=208). I investigated associations between discrete factors of the best-fitting model and common menopause and aging-related health concerns, including: 1) vasomotor, urinary, and vaginal symptoms; 2) vasomotor symptom interference on women's daily functioning; and 3) two indicators of sexual functioning. I hypothesized that the fear-based PTSD dimensions—namely, re-experiencing and anxious arousal—would be particularly associated with the menopause and aging-related symptoms, while anhedonia and dysphoric arousal would be most strongly linked with the sexual correlates. I also anticipated negative affect to be of principal importance to all health markers.

Results: Though all models fit well, a six-factor anhedonia model provided optimal fit. Greater symptoms across all discrete dimensions—re-experiencing, avoidance, negative affect, anhedonia, anxious arousal, and dysphoric arousal—were linked with greater urinary and vasomotor, but vaginal, symptoms. Comparison of associations for distinct dimensions revealed that negative affect and dysphoric arousal were particularly associated with urinary health, while dysphoric arousal emerged as the factor most strongly related to vasomotor symptom interference. All PTSD symptom dimensions were linked with adverse sexual functioning, in the

form of both vaginal symptom interference and low sexual desire; no dimensional distinctions were consistently observed across these sexual health indicators.

Conclusion: PTSD symptoms in midlife women veterans were best-represented by six factors. While multiple aspects of posttraumatic distress were relevant to menopause- and aging-related health and sexual functioning in this population, negative affect and dysphoric arousal symptoms were especially important to urinary and vasomotor symptoms. These dysphoria-related PTSD symptoms may drive associations between post-trauma psychopathology and menopause-related health, though longitudinal research testing mechanisms is needed. Screening for and intervening on PTSD symptomatology may promote women's health during midlife and beyond.

Introduction

The menopause transition—the formal end of the reproductive-aged years—is a universal experience for midlife women. This transitory time involves both the cessation of menstrual periods, as well as the onset of a host of physical symptoms: hot flashes and night sweats (collectively termed vasomotor symptoms), urinary problems, and vaginal issues. These menopause and aging-related symptoms are common, affecting approximately 50-80% of midlife and older women across the menopause transition (Huang et al., 2010; Woods & Mitchell, 2005). While normative, the duration, frequency, and severity of these symptoms can vary considerably—with some clinical presentations persisting for as long as decades after the final menstrual period (Avis et al., 2015; Mishra & Dobson, 2012; Politi, Schleinitz, & Col, 2008) and prompting as many as 60% of women to seek symptom management in the healthcare system (Williams et al., 2007). Unmanaged, these vasomotor and genitourinary symptoms can also interfere with healthy aging (e.g., increase risk for incident cardiovascular events, as in Thurston et al., 2021) and quality of life (Avis et al., 2003; Whiteley et al., 2013), and a sizable proportion of women experience these physical symptoms as disruptive and distressing. Greater understanding of correlates of these menopause and aging-related symptoms and their sequelae may inform interventions to improve women's health during midlife and beyond.

Prevalence, Correlates, and Predictors of Menopause-Related Symptoms

Most of what is known to date about menopause and aging-related symptoms is drawn from the Study of Women's Health Across the Nation (SWAN), a multi-site, longitudinal cohort study of midlife women. Initiated in 1996, SWAN was designed to characterize the biopsychosocial antecedents and consequences of the menopause transition. As the first cohort study of non-treatment-seeking midlife women, SWAN established that approximately 80% of

women experience vasomotor symptoms—the key menopause-related symptom, as well as the symptom with the largest amount of research on it—at some point during the transition, with greater prevalence in early to late perimenopause (Gold et al., 2006). Despite the near ubiquity of this symptom, women can vary widely in the duration and severity of vasomotor experiences; indeed, SWAN elucidated racial and ethnic disparities in vasomotor symptoms, with Black women reporting the highest prevalence, longest duration, and most symptom-related bother (Avis et al., 2015; Gold et al., 2006; Thurston et al., 2008). Other work has found that several other factors are linked with vasomotor symptom burden, including smoking, greater symptoms of depression and anxiety, and greater symptom sensitivity—all of which are associated with greater vasomotor symptom reporting. Depressed and anxious mood have also been linked with greater perceived symptom bother—even independent of symptom frequency (Thurston et al., 2008).

Though not a menopause-specific symptom, urinary issues—including incontinence and nocturia—also become more common as women age. Nearly 70% of women in SWAN reported monthly or more frequent experiences of incontinence during the follow-up period (El Khoudary et al., 2019; Waetjen et al., 2015), and a more thorough assessment that included measures of symptom frequency and severity found that 10-15% of women classified their urinary experiences as moderate-to-severe (Sampselle et al., 2002). Vulvovaginal symptoms such as pain with sex, dryness, and irritation also become more prevalent later in the menopause transition, with reports estimating that between 21-34% of postmenopausal women experience these symptoms (El Khoudary et al., 2019; Woods & Michell, 2005). While risk for these genitourinary symptoms is often largely attributed to aging-related biological changes and the vulvovaginal atrophy secondary to estrogen loss, substantial amounts of variance in their

prevalence and severity remain unexplained, and less is known about psychosocial correlates and risk factors for these menopause and aging-related experiences relative to vasomotor symptoms.

Trauma and Menopause-Related Health

An often-unaddressed variable in the clinical care of older women (Cook, 2022), trauma exposure may be another important psychosocial risk factor that contributes to greater menopause-related symptom burden. For example, a history of childhood trauma has been linked with elevated likelihood of vasomotor symptoms—as assessed both through women's self-report (Kapoor et al., 2021; Thurston et al., 2008) and physiological monitoring (Carson & Thurston, 2019)—in women during midlife. Greater exposure to early adverse experiences has also been linked with greater severity of other menopause-related symptoms, including urogenital symptoms (Kapoor et al., 2021), and one recent longitudinal study found that a history of psychosocial stressors—including abuse and other traumatic experiences—was associated with greater reporting of menopause-related symptoms decades later (Faleschini et al., 2022). Other work has linked past-year trauma exposure with elevated risk of, and more bothersome, genitourinary symptoms (Gibson, Lisha et al., 2019; Vegunta et al., 2016), suggesting that both proximal and distal traumatic experiences can play a role in menopause-related health.

Though all women are at-risk for potential trauma exposure and its effects, these associations may be particularly relevant to women veterans, who are more likely to experience trauma across their lifespans (Katon et al., 2015; Zinzow et al., 2007) relative to their civilian counterparts. Further, by virtue of their roles as servicemembers, women veterans are uniquely exposed to certain traumas, including combat and military sexual trauma (MST), that may have differential impacts on menopause-related health. One study in a nationally representative sample of women veterans found that experiences of MST were linked with more severe and

interfering menopause symptoms (Frayne et al., 1999), while other work in women veterans has linked diverse military trauma types (e.g., wartime exposure, MST) with elevated genitourinary symptoms (Smith et al., 2011; Wachen et al., 2013).

Posttraumatic Psychopathology as a Potential Mechanism

The psychological sequelae secondary to trauma exposure may further exacerbate these menopause and aging-related symptoms. Accordingly, a small, but growing, literature has examined associations between posttraumatic stress disorder (PTSD)—the signature trauma-related mental health disorder—and menopause-related health concerns. Most of this research has leveraged cross-sectional data from the Reproductive Risks of Incontinence Study at Kaiser (RRISK), an observational cohort study of women aged 40-80 years receiving care from an integrated healthcare system in Northern California. In this large, multi-ethnic sample, multiple forms of interpersonal trauma (e.g., intimate partner violence [IPV], sexual assault) and current PTSD symptoms were associated with greater vasomotor and vaginal symptoms (Gibson, Huang et al., 2019). As the authors note, several significant associations between the discrete trauma types and these menopause-related correlates dissipated in models including PTSD symptoms. Another RRISK study found that elevated PTSD symptoms were linked with reports of moderate-to-severe bladder pain, with no evidence supporting associations between interpersonal trauma and this form of urinary health; however, all forms of violence studied and PTSD symptoms were associated with a history of urinary tract infections (Raphael et al., 2022). Moreover, while findings linking the discrete trauma types and other urinary problems (e.g., incontinence, nocturia) were mixed, PTSD symptoms were consistently associated with all assessed urinary difficulties (Boyd et al., 2020). Taken together, these findings support posttraumatic stress as a mechanism linking trauma exposure with menopause-related health.

Indeed, theoretical models suggest that posttraumatic psychopathology—rather than trauma itself—particularly accounts for adverse health outcomes, likely through complex and interacting behavioral (e.g., smoking, physical inactivity) and biological (e.g., alterations in HPA axis, chronic systemic inflammation) pathways (Schnurr et al., 2021). While models considering these mechanistic pathways have been more frequently applied to trauma-related psychopathology and other adverse physical health problems (e.g., cardiovascular risk, as reviewed in Sumner et al., 2023), to my knowledge, no work has yet considered the mechanisms through which PTSD may lead to greater or more interfering menopause and aging-related symptoms.

Theoretically plausible paths exist. As examples, meta-analytic evidence links PTSD with engagement in negative health behaviors such as smoking (van den Berk-Clark et al., 2018), a lifestyle factor also linked with elevated risk of menopause symptom burden; a large cross-sectional analysis that pooled data from over 20,000 midlife women found that smoking—defined with regard to number of cigarettes, for longer durations of time, and when initiated earlier in the lifecourse—was associated with more frequent and severe vasomotor symptoms (Anderson et al., 2020). Physiologically, PTSD is linked with systemic inflammation (for a review, see Sumner, Nishimi et al., 2020)—a risk factor for a host of aging-related chronic diseases, many of which become more common in women following menopause—and inflammation has also been associated with vasomotor symptom prevalence (Gold et al., 2022; Thurston et al., 2011). These are merely two examples of a multitude of potential pathways that could explain associations between PTSD and menopause-related health; however, as aforementioned, research has yet to test these potential mechanisms. Clarifying the role of PTSD—and studying mechanisms by which posttraumatic psychopathology may lead to greater

prevalence of these menopause and aging-related symptoms—could move the field toward more precise understanding of determinants of menopause-related health in trauma-exposed women.

Posttraumatic Psychopathology and Menopause-Related Healthcare

The effects of trauma and related psychopathology may extend from menopause-related symptom experience to subsequent management, in the form of healthcare decisions that may shape risk for aging women's health. For example, oral, patch, or cream hormone therapies are commonly prescribed to treat menopause-related symptoms in the general population, with a recent national survey demonstrating that nearly one in ten midlife and older women uses hormone therapy (Gass et al., 2015). As demonstrated by landmark findings from the Women's Health Initiative (WHI; Rossouw et al., 2002), prolonged use of hormone therapy is linked with increased risk of certain chronic medical conditions (e.g., cardiovascular disease), a finding that spurred clinical recommendations to emphasize its prescription be exclusive to menopause symptom management and its duration of administration regularly monitored (North American Menopause Society, 2022). Importantly, initial recommendations from the WHI overemphasized the risks of hormone therapy for menopause-related symptom management, in that the trial—designed to examine the long-term effects of these treatments in reducing coronary heart disease in older women—did not adequately test these interventions for short-term treatment of menopausal symptoms in younger women. Subsequent research has since validated that for healthy women under age 60 with bothersome hot flashes, the benefits of hormone therapy outweigh the risks (North American Menopause Society, 2022), in that its administration can improve quality of life and aid in symptom relief among these subgroups.

Given that its prescription is often reserved for midlife women reporting symptoms as interfering, receipt of hormone therapy may be viewed as an indicator of greater menopause-

related symptom burden and bother. Indeed, research leveraging large epidemiological samples and administrative data has found that trauma and PTSD—operationalized both as a discrete diagnosis and as a total symptom burden score—are linked with elevated odds of hormone therapy utilization in women veterans and community-dwelling women (Gerber et al., 2015; Lawn et al., 2020). These associations may be a function of the more frequent and severe menopause-related symptoms endorsed by trauma-exposed women. Other work has shown that women with PTSD are vulnerable to earlier menses cessation—which is also is linked with chronic health conditions and premature death (Shuster et al., 2010)—via medical intervention. In one longitudinal study of over 46,000 women, PTSD symptoms were associated with greater risk of pre-menopausal gynecological surgeries, but not natural menopause (Nishimi et al., 2022). It is possible that PTSD-affected women are more sensitive to pain or distress (Phifer et al., 2011)—whether that may manifest as greater susceptibility to and reporting of menopause-related symptoms and associated bother or as the indications for hysterectomy (e.g., endometriosis, uterine fibroids)—which may then influence preferences for clinical intervention. Moreover, women with PTSD may also have more interactions with the healthcare system (Greene, Neria, & Gross, 2016), thereby fostering more opportunities to discuss different medical strategies for symptom management with providers.

Relying solely on utilization of medical management strategies may underestimate these associations. For example, data suggest that many healthcare providers remain hesitant to prescribe hormone therapy for menopause symptom relief, even if women may be appropriate candidates; indeed, hormone therapy initiation and utilization rates have decreased since the WHI, including among subgroups for whom it is recommended (e.g., women with more vasomotor symptoms; Crawford et al., 2018). Thus, hormone therapy receipt may not capture all

women experiencing bothersome symptoms. Given availability of more granular data (e.g., presence and interference of menopausal symptoms—which may precede or ultimately contribute to the decision to pursue medical intervention) in this study, I elected to present hormone therapy and menopause status for descriptive, rather than inferential, purposes.

Sexual Functioning During Midlife

Another important component of women's health during and beyond the menopause transition is sexual functioning. Most, though not all, longitudinal studies support sexual dysfunction as a common consequence of advancing menopause status (for a review, see Thomas & Thurston, 2016), even independent of chronological age (Avis et al., 2009; Woods et al., 2010; for a review, see Dennerstein, Alexander, & Kotz, 2003), and research in peri- and postmenopausal samples documents genitourinary and vasomotor symptoms as correlates of sexual difficulties and distress (Mishra et al., 2006; Moral et al., 2018; Shifren et al., 2008; Woods et al., 2010). Several complex and dynamically interacting biological, psychosocial, and social factors likely play a role in these changes. For example, the physiological processes underlying the menopause transition—including decreases in estrogen that result in vaginal dryness, irritation, and atrophy (Novi & Book, 2009)—precipitate changes in libido and genital response (Dennerstein et al., 2003). Midlife women navigate these physiological challenges amid changing psychosocial contexts that could influence sexual functioning, including increased vulnerability to both medical and mental health conditions, interpersonal relationship transitions (e.g., divorce), and sociocultural attitudes around women and aging (Thomas & Thurston, 2014).

Posttraumatic Stress and Sexual Health

Posttraumatic psychopathology may understandably exacerbate sexual health problems during this transitory time. While research has shown PTSD to be a common correlate of sexual

dysfunction (Yehuda et al., 2015), including among women veterans (Rosebrock & Carroll, 2017; Pulverman & Creech, 2021), most work on associations among this subgroup has studied reproductive-aged women (e.g., Cohen et al., 2012). Indeed, two recent longitudinal studies conducted in samples of younger and midlife women and men veterans demonstrated that posttraumatic stress symptomatology explained associations between military trauma exposure—including MST and combat—and adverse sexual health outcomes—operationalized as experiencing either bothersome pain during sex or low sexual desire—in these populations (Kolaja, Roenfeldt et al., 2021; Kolaja, Schuyler et al., 2021). In midlife and older women exposed to interpersonal violence, posttraumatic stress symptoms have been cross-sectionally linked with both with vaginal symptoms (e.g., dryness, irritation) and pain with sex (Gibson, Huang et al., 2019). Less is known about PTSD and other aspects of sexual health and functioning—including low sexual desire, a variable consistently associated with the menopause transition and prominent during midlife (Thomas & Thurston, 2016)—in this population.

That said, a recent systematic review on PTSD and sexual difficulties in military populations identified thirteen studies that considered sexual desire, nine of which demonstrated negative associations between posttraumatic psychopathology and this aspect of sexual functioning (Bird et al., 2021). Only one of these studies focused on women veterans (Garneau-Fournier, Habarth, & Turchik, 2020), all of whom had been exposed to MST; in this cross-sectional survey of a national Veterans Health Administration (VHA) sample, women with probable PTSD—based on endorsing three of the four questions on the Primary Care PTSD screen (PC-PTSD; Prins et al., 2003)—were more likely to report low sexual desire than their non-PTSD counterparts. Women in this study were, on average, approximately 50 years of age, though the range was wide (21-89 years), and thus could be considered midlife; however, given

the truncated nature of the PC-PTSD, research using expanded measures of PTSD symptoms is needed to understand whether select aspects of posttraumatic distress are particularly relevant to sexual desire during midlife.

Moreover, as was the case in this study by Garneau-Fournier and colleagues (2020), research examining associations between traumatic stress and sexual dysfunction often, though not always, study survivors of sexual violence specifically (Bird et al., 2021). It follows that these survivors might experience sexual difficulties even in the absence of PTSD, as sexual activity can serve as a potent reminder of trauma. However, aligned with theoretical models positing that posttraumatic distress accounts for adverse health above and beyond trauma exposure (Schnurr et al., 2021), sexual dysfunction is more pronounced in survivors with PTSD relative to those without it—an effect that persists regardless of trauma type (Letourneau et al., 1996; Yehuda et al., 2015). Posttraumatic psychopathology may both physiologically and psychologically predispose survivors to sexual challenges. For example, the biological underpinnings of sexual arousal parallel the physiological processes of PTSD's fear response (Yehuda et al., 2015); an inability to downregulate could interfere with an individual's capacity present during paired sexual activity. Emotional experiences—including posttraumatic numbing, restricted affect, and interpersonal detachment—may also give rise to difficulties with arousal or desire. While many of the characteristics of PTSD may be relevant to sexual functioning, select symptom dimensions may be particularly important to the experience of low sexual desire during midlife. As such, adopting a dimensional approach to posttraumatic psychopathology—one that parses apart the distinct components of posttraumatic stress—may be warranted.

Dimensional Approaches to Posttraumatic Stress

As a diagnosis, PTSD is a highly heterogeneous clinical phenomenon, in that there are more than 636,000 potential symptom combinations to meet *DSM-5* diagnostic criteria (Galatzer-Levy & Bryant, 2013). Beyond mathematical probability of PTSD's heterogeneity, research also supports marked diversity in its clinical manifestations; in one study of over 3,500 servicemembers, 55.1% of individuals who met PTSD criteria endorsed a unique pattern of symptoms (Bryant, Galatzer-Levy, & Hadzi-Pavlovic, 2022). To date, examinations of associations between posttraumatic stress and menopause-related health have considered PTSD as either a unitary diagnostic construct—most often classified as probable PTSD based on elevated symptoms—or as a total symptom severity score. While informative, these operationalizations cannot facilitate greater understanding of which aspects of posttraumatic psychopathology are most relevant to these important health markers during midlife and beyond.

To parse the heterogeneity of posttraumatic psychopathology into more homogeneous and clinically informative symptom manifestations, a large body of research has investigated the underlying factor structure of PTSD in diverse trauma-exposed samples (Armour et al., 2016). This research influenced the diagnostic criteria adopted for *DSM-5* PTSD, which utilizes a four-factor model (American Psychiatric Association, 2013). Other research has supported even more nuanced and refined models of PTSD symptoms based on *DSM-5* criteria, including a five-factor dysphoric arousal model (Tsai et al., 2014)—also identified as the best-fitting model for *DSM-IV-TR* PTSD (Armour et al., 2016); a six-factor anhedonia model (Liu et al., 2014); and a six-factor externalizing behaviors model (Tsai et al., 2014). A recent seven-factor model (Armour et al., 2015) integrated both six-factor models, resulting in dimensions of re-experiencing, avoidance, negative affect, anhedonia, externalizing behaviors, anxious arousal, and dysphoric arousal. While all models retain factors for re-experiencing and avoidance symptoms, they differ

in their classification of those remaining. For example, while the *DSM-5* model classifies six symptoms (e.g., hypervigilance, sleep disturbance, irritability) into a broad factor reflecting alterations in arousal and reactivity, the other models distill these into various subsets reflecting anxious arousal, dysphoric arousal, and externalizing behaviors (see Table 1 for item mappings).

Most *DSM-5* research comparing dimensional approaches (though not all; see Konecky et al., 2016) supports the seven-factor hybrid as the best current representation of the underlying structure of PTSD (Armour et al., 2016). The majority of research involving this model has been conducted among disaster-exposed adolescents (Li et al., 2018; Yang et al., 2017) or select samples of mostly men veterans (e.g., veteran subsample in Armour et al., 2015; Lee et al., 2019; Pietrzak et al., 2015), and only one study to date has tested its fit among active duty and women veterans (Blais, Geiser, & Cruz, 2018). Though the seven-factor hybrid model fit the data well in this sample, the authors did not test for differences in model fit by systematically comparing fit indices for this and the five other dimensional models evaluated (Blais et al., 2018). Comparing fits across dimensional models of PTSD symptoms is critical to better understand nuances in how posttraumatic psychopathology manifests in particular populations, in service of accurately characterizing—and ultimately appropriately intervening upon (Bovin, Marx, & Schnurr, 2015)—posttraumatic distress. Further, findings from factor analytic studies continually influence the evolving diagnostic criteria for PTSD; for example, *DSM-IV* research concerning PTSD's dimensional structure resulted in the *DSM-5*'s adaptation of a four-factor model.

There may also be clinical utility in identifying correlates of the emergent symptom dimensions from the best-fitting model, such that these PTSD symptoms can then be targeted in screening and intervention efforts in order to improve health. Toward this way of thinking, a small literature has examined associations between PTSD dimensions and specific physical

health outcomes, in service of elucidating mechanisms (i.e., potential clinical targets) potentially driving comorbidity between posttraumatic psychopathology and health conditions. For example, using data from the Nurses' Health Study II, researchers found that re-experiencing symptoms were particularly associated with incident hypertension (Sumner, Kubzansky et al., 2020). Another study in a large sample of predominantly men veterans found that dysphoric arousal was the sole dimension linked with all comorbid physical health conditions associated with probable PTSD, including sleep disorders, respiratory conditions, osteoporosis/osteopenia, and migraines (El-Gabalawy et al., 2018). Importantly, most of these studies have considered PTSD according to *DSM-IV* diagnostic criteria, which differs from later iterations with regard to the included symptoms, and thus have employed four- or five-factor dimensional models of PTSD symptoms.

Growing *DSM-5* PTSD research has tested the more nuanced hybrid model and demonstrated differential associations between its seven dimensions and various outcomes. For example, in samples of veterans, externalizing behaviors—comprised of irritability and self-destructive or reckless behavior—is the dimension most strongly associated with suicidal ideation (Pietrzak et al., 2015) and aggressive driving (Lee et al., 2019). Other work has demonstrated that across both veteran and civilian samples, the dysphoric arousal dimension is particularly linked physical functioning and health-related quality of life (Li et al., 2018; Pietrzak et al., 2015). However, research examining the hybrid dimensional model in the context of specific health conditions and symptoms is lacking.

Applying a Dimensional Perspective to PTSD and Menopause-Related Health

To my knowledge, no research has yet examined the relationship between PTSD dimensions and menopause and aging-related symptoms in midlife women. While many elements of posttraumatic distress may be relevant to menopause-related health, the fear-based

symptom dimensions—including re-experiencing and anxious arousal—may be especially important to the physical health symptoms that can onset during this time. Often considered among the hallmark features of PTSD (Zoellner et al., 2014), these fear-based symptom dimensions capture physiological arousal and reactivity and are particularly aligned with the autonomic nervous system and HPA-axis dysregulation characteristic of PTSD (Pitman et al., 2012; Williamson et al., 2014). Vasomotor systems also implicate these biological stress systems (Gibson, Thurston, & Matthews, 2016; Monteleone et al., 2018; Thurston et al., 2016), and urinary difficulties—another key health issue during midlife and beyond—are similarly theorized to result, in part, from stress-induced alterations in corticotropin-releasing factor (Klausner & Steers, 2004). It is plausible that common pathophysiological processes underlie both these PTSD symptom dimensions and menopause-related symptoms. At the psychological level, both intrusions—the hallmark PTSD symptom of the re-experiencing dimension—and menopause symptoms may be perceived by women as uncontrollable and invasive, thereby potentiating greater emotional impact of these health concerns (Hunter & Liao, 1995; Hunter & Mann, 2010) and potentially perpetuating them.

While not an element of the fear response, dysphoric arousal—a symptom dimension characterized by sleep and concentration difficulties—may also be particularly important given potential etiological and conceptual overlap between this aspect of posttraumatic stress and components of menopause-related health. For example, sleeping difficulties are among the most commonly endorsed symptoms of PTSD (Ohayon & Shaprio, 2000), and women experiencing night sweats often also experience restless sleep (Baker et al., 2018; Freedman & Roehrs, 2007). Further, specific urinary problems like nocturia—or awakening in the night to urinate—implicate sleep disturbance by their very nature. With regard to concentration difficulties, many women

report cognitive changes—including "brain fog" and forgetfulness—during and after menopause (Greendale, Karlamangla, & Maki, 2020), and PTSD's dysphoric arousal symptoms may exacerbate these experiences. Moreover, such difficulties with both sleep and concentration may also influence symptom perception and bother, in that women struggling with these become more sensitive to the experience of vasomotor and genitourinary symptoms.

Negative affect symptoms of PTSD—including persistent negative emotions, beliefs, and blame—may also be especially relevant to menopause-related health. Indeed, generalized negative affect is a common correlate of vasomotor symptoms (for a review, see Thurston & Joffe, 2011), an unsurprising finding given the unpleasant and disruptive nature of these experiences. Negative affect more broadly is also associated with a low threshold for detecting physical sensations (Kolk et al., 2003), which may potentiate awareness of and subsequent reporting of menopause symptoms (Aronson, Barrett, & Qyigley, 2006; Hunter & Mann, 2010). Importantly, negative affect is also a core feature of multiple forms of psychopathology beyond PTSD, including depression and anxiety (Clark & Watson, 1991)—the symptoms of which have also been linked with menopause-related symptoms (Juang et al., 2005; Seritan et al., 2010).

In contrast to these four dimensions, the avoidance symptoms of posttraumatic psychopathology—which reflect emotional and behavioral avoidance of trauma-specific reminders—may not be as directly relevant to the physiological and psychological processes underlying these menopause and aging-related symptoms, and, anhedonia—a dimension characterized by loss of interest, interpersonal detachment, and restricted affect—may also be less relevant than other dimensions. Better understanding of which components of posttraumatic stress are most linked with menopause-related health may inform more precise research on

mechanisms and, ultimately, more targeted interventions appropriate for dissemination during and after menopause.

Considering Dimensional Approaches to PTSD and Sexual Health in Midlife Women

More work, albeit a limited literature, has considered PTSD symptom dimensions and sexual functioning. Most of this research has focused on reproductive-aged women, whose sexual health concerns often center around family planning and pregnancy rather than the low sexual desire that is more typical during midlife and beyond. For example, I previously demonstrated using *DSM-IV* PTSD criteria that the dysphoric arousal symptom dimension—inclusive of symptoms such as sleeping problems and attention difficulties—was uniquely linked with use of less-efficacious contraceptive methods (e.g., withdrawal, condoms) among postpartum women (Thomas, Cleveland et al., 2021). To my knowledge, only two studies have specifically studied PTSD symptom dimensions and sexual functioning in women veterans and service members, and both samples were predominately comprised of reproductive-aged women. One of these studies, which utilized a four-factor conceptualization of *DSM-IV* PTSD criteria, found that emotional numbing and hyperarousal symptoms were most closely linked with sexual dysfunction—defined as sexual dissatisfaction and sexual problems in relationships—among this population (Schnurr et al., 2009). Importantly, in subsequent dimensional models using *DSM-5* PTSD criteria, the symptoms captured by *DSM-IV*'s emotional numbing and hyperarousal clusters have been re-categorized under diverse factors—including negative alterations in cognition/mood, negative affect, and anhedonia dimensions, dependent on the specific factor model—and alterations in arousal and reactivity and dysphoric arousal, respectively. Aligned with these changes in nosology, study in reproductive-aged military women examined the six factors of the anhedonia model of *DSM-5* PTSD symptoms and observed that only the anhedonia

and dysphoric arousal factors significantly explained associations between MST exposure and sexual functioning (Blais et al., 2018). Though data from both of these studies were cross-sectional and thus limit claims regarding causality, the consistency of these findings regarding these dimensions suggest their relevance for women's sexual health.

Further, while no research has yet examined PTSD dimensions and sexual functioning in midlife women, it follows that the anhedonia and dysphoric arousal dimensions may continue to be particularly relevant to low sexual desire during this time of life. The symptoms that comprise the anhedonia dimension under the most refined PTSD factor models—including loss of interest, interpersonal detachment, and restricted affect—reflect an inability to experience and express emotion, which may relate to inhibited capacity to experience pleasure, arousal, and desire during sexual activity. Dysphoric arousal symptoms such as concentration and sleep difficulties may also be particularly linked with low sexual desire; these symptoms can also interfere with effective emotion regulation, thereby contributing to low desire. Symptoms of negative affect—including persistent negative feelings and exaggerated beliefs and self-blame—may also be relevant, as these are largely incompatible with intimacy, trust, and safety—essential components of healthy sexual relationships—and thus may influence interpersonal relationships and the experience of paired sexual activity. In contrast to these dimensions, re-experiencing and avoidance may be less directly relevant to sexual desire, as these symptoms are more anchored in psychological responses and distress as related to specific trauma-related reminders rather than more generalized affect. However, research in midlife women is needed to better understand which, if any, components of posttraumatic stress may be most relevant to low sexual desire.

Objective of the Present Study

To date, the limited research on PTSD and menopause-related health in women has considered this form of posttraumatic psychopathology as a discrete diagnostic construct or a total symptom score. While informative, these operationalizations cannot facilitate greater understanding of if select components of posttraumatic stress may be particularly relevant to midlife women's health. Studying links between discrete aspects of PTSD and menopause- and aging related health may shed light on candidate mechanisms driving associations and illuminate potential intervention targets of particular clinical relevance.

Toward that end, in this study, I evaluated the underlying dimensional structure of PTSD in a sample of midlife women veterans with high rates of trauma exposure. Based on support for the seven-factor hybrid model (Armour et al., 2015) across a variety of trauma-exposed populations (Armour et al., 2016), I hypothesized that this model would provide optimal fit to the sample data. I then examined associations between the symptom dimensions of the best-fitting model and correlates representing menopause and aging-related symptoms and sexual functioning. Aligned with prior research on PTSD symptom dimensions and health among reproductive-aged women (e.g., perinatal populations as in Thomas, Cleveland et al., 2021; women veterans and service members as in Blais et al., 2018), I hypothesized that there would be differential associations between the emergent symptom dimensions and menopause- and aging-related symptoms and sexual sequelae. Specifically, I predicted that the fear-based symptom dimensions—namely, re-experiencing and anxious arousal—would be particularly associated with menopause symptoms (e.g., vasomotor), given co-occurring physiological processes common to both posttraumatic psychopathology and these menopause-related experiences (Monteleone et al., 2018). In contrast, I hypothesized that the anhedonia and dysphoric arousal dimensions would be most strongly linked with sexual functioning (Blais et al., 2018). I also

hypothesized that symptoms of negative affect would be particularly linked with both the menopause- and aging-related symptoms and their sexual sequelae.

Methods

Study participants included cisgender women veterans 45-64 years of age without active diagnoses of dementia or psychosis. Women meeting these criteria were recruited to participate in a cross-sectional survey of midlife health if they had completed a clinical encounter within one of three Bay Area VHA locations within the previous two years. Eligible women were mailed information packets containing study information and "opt-out" postcards through which to decline participation. Those who did not return signed consent forms or postcards within two weeks were followed-up with via phone. Enrolled participants completed either paper-and-pencil or electronic surveys assessing menopause and aging-related symptoms, medical and mental health comorbidities, and menopause-related healthcare. Data were collected from March 2019 to May 2020. A total of 232 enrolled women completed the survey (94% of those approached); for this study, the analytic sample comprised the women with complete PTSD data (N=208).

Measures

PTSD symptoms. PTSD symptoms were assessed using the PTSD Checklist for *DSM-5* (PCL-5; Weathers et al., 2013), as anchored to "a very stressful experience." Women indicated how bothered they were by each of 20 *DSM-5* PTSD symptoms in the past month, with responses rated on a 5-point scale (1=Not at all, 5=Extremely). These item-level responses were summed to create a total PTSD symptom severity score (Cronbach's α=.96), with the individual items themselves treated as ordinal indicators in the confirmatory factor analyses (CFAs) examining dimensional models. The PCL-5 is psychometrically sound, demonstrating strong reliability and validity in both civilian (Blevins et al., 2015) and veteran (Bovin et al., 2016)

populations. For descriptive purposes, I also examined scores categorically, using a cut-off score of ≥33 to indicated elevated PTSD symptom severity (Bovin et al., 2016), as done in previous research among women veterans (e.g., Lehavot et al., 2021).

Most research using the PCL-5 administers the measure without a specified Criterion A (for a review, see Forkus et al., 2023), as was the case in this study. However, women in this study also reported on three exposures related to interpersonal trauma—including lifetime experiences of MST, non-military sexual trauma, and IPV—that were consistent with the definition of *DSM-5*'s Criterion A (e.g., individual directly experienced or witnessed event(s) involving actual or threatened death, serious injury, or sexual violence; American Psychiatric Association, 2013). Specifically, to capture experiences of MST, women answered the following two questions—drawn from VHA's MST screening protocol—as anchored to their time in the military: *Did you receive uninvited and unwanted sexual attention, such as touching, cornering, pressure for sexual favors, or verbal remarks?* and *Did someone ever use force or the threat of force to have sexual contact with you against your will?* Affirmative responses to either question were coded to indicate MST, as is typical in VHA clinical practice and in MST research (Wilson, 2018). Women reported on lifetime experiences of non-military sexual assault via the following: "Outside of your time in the military, has someone who wasn't your partner ever touched you sexually against your will or without your consent, or forced or pressured you to have sex?" IPV was assessed via an adapted version—in that it focused on both past-year and lifetime IPV experiences of physical, psychological, and sexual violence—of the "Extended—Hurt Insult Threaten Scream" (E-HITS; Chan et al., 2010, based on Sherin et al., 1998), a five-item measure assessing frequency of IPV experiences. Responses were scored on a 5-point scale (1=Never, 5=Frequently) and then summed. Initially validated in a Chinese sample of women seeking

emergency services (Chan et al., 2010), the E-HITS has also been used to study IPV in women veterans (Goldstein et al., 2023; Iverson et al., 2015). I considered women with total E-HITS scores ≥7—a cut score validated in a sample of women veterans (Iverson, et al., 2015)—as IPV-exposed.

To increase confidence in the assumption that the PCL-5 is capturing trauma-related psychopathology, I summed affirmative responses across these three measures to create a total score indicative of interpersonal trauma burden; I then examined associations between this marker and total PTSD symptoms. Because lifetime trauma burden is associated with greater PTSD symptom severity (Wilker et al., 2015), I anticipated a positive correlation of a small-to-moderate magnitude, which would lend additional credence to this measure of PTSD symptoms. As the primary aim of this study is to investigate associations between PTSD symptoms—the theorized mechanism linking trauma exposure with adverse health—and these correlates relevant to midlife women, I reported the prevalence of these trauma exposures and their correlation with PTSD symptoms in descriptive statistics only.

Menopause and aging-related health correlates. I considered *urinary*, *vasomotor*, and *vaginal* symptoms as discrete sets of menopause and aging-related health correlates. Building on the existing literature examining associations between PTSD as a discrete diagnosis and menopause-related health in aging women (Gibson, Huang et al., 2019), composite scores for each set of these symptom sets were created to reflect presence or absence of recent symptoms.

Specifically, women rated the frequency with which they had experienced urinary incontinence over the past three months and nocturia (urinating multiple times during the night) over the past two weeks. Responses were combined into a single composite score and dichotomized into a *urinary symptoms* indicator to indicate any experience of recent symptoms.

Women also reported the frequency with which they experienced hot flashes and night sweats over the past two weeks. Responses were summed across the two items and then dichotomized to reflect presence versus absence of *vasomotor symptoms*. Women who endorsed vasomotor symptoms also completed the Hot Flash Related Daily Interference Scale (HRFDIS; Carpenter, 2001), a 10-item psychometrically sound and clinically sensitive (e.g., Soares et al., 2010) measure that assesses the degree to which hot flashes interfere with daily activities (work, leisure, social) and quality of life. Item-level responses are summed to create a total score (Cronbach's α=.95), which was treated as an additional menopause-related health correlate. Finally, women indicated if they had experienced vaginal dryness, vaginal irritation or itching, or pain during either partnered or solo sexual activity during the past month. Endorsements were summed to create a composite score representative of *vaginal symptoms* and then dichotomized.

Sexual functioning. Women completed six items drawn from the short-form version of the sexual functioning subscale of the Day-to-Day Impact of Vaginal Aging (DIVA) Questionnaire (Huang et al., 2015), a multidimensional scale that assesses the impact of vaginal symptoms on important life domains (e.g., well-being, activities of daily living). The DIVA has been used to characterize women's experiences of vaginal symptoms and sexual functioning across diverse samples of postmenopausal women (Gibson et al., 2020; Huang et al., 2015; Hunter et al., 2016; Hunter et al., 2020), and a recent review of its implementation determined the measure to have strong structural validity and internal consistency, as well as adequate reliability (Gabes et al., 2019). The subscale used in this study consisted of five questions appropriate for all women regardless of if they are currently sexually active. Women were asked to assess the degree to which vaginal symptoms interfered with their sexual functioning over the past month, with responses rated on a 5-point Likert scale (e.g., 0=Not at all, 4=Extremely). A

sample question is, “During the past 4 weeks, have vaginal symptoms (dryness, soreness, irritation, or itching) affected your desire or interest in having sexual intercourse or other types of sexual activity (including self-stimulation or masturbation)?” In addition to the five items from this short-form, one question contingent on engagement in sexual activity was also included (e.g., “During the past 4 weeks, have vaginal symptoms affected your ability to become aroused during sexual activity, including self-stimulation/masturbation?”). For this question only, women could select a response option labelled “not applicable—not sexually active.” A total sexual functioning score (Cronbach’s α=.90) was calculated by averaging the scores of these six items, with higher scores indicating more severe interference of vaginal symptoms.

Women also completed the Female Sexual Distress Scale Revised (FSDS-R; Derogatis et al., 2008), a 13-item scale that assesses frequency with which an individual experienced distress linked with sexual functioning over the last four weeks. The original version of the FSDS was validated in 2002 in a postmenopausal sample (Derogatis et al., 2002), and the revised version—which added a question assessing bother by low desire—was evaluated in a sample of predominantly premenopausal women in monogamous heterosexual relationships lasting at least one year. This research found the FSDS-R to be a reliable measure with excellent sensitivity and specificity and good discriminant validity. Indeed, total scores $\geq$11 successfully identified 92.7% of women who met *DSM-IV-TR* criteria for hypoactive sexual desire disorder based on a clinical diagnostic interview (Derogatis et al., 2008). A sample question is, “How often did you feel stressed about sex?” Responses are rated on a 5-point scale of frequencies (0=Never, 4=Always), such that higher scores reflect greater distress. As low desire is common during midlife (Thomas & Thurston, 2016) and because related distress is a key diagnostic feature of sexual dysfunction

disorders (Parish & Hahn, 2016), the cut-score ≥11—indicative of clinically significant sexual distress, as consistent with a diagnosis of hypoactive sexual desire disorder—was used.

Sociodemographic and clinical information. Women provided sociodemographic data (age, race/ethnicity, educational attainment, sexual orientation, marital status), as well as reported their era and duration of military service. Menopause status was derived from self-reported date of last menstrual period and hysterectomy/oophorectomy status. Current receipt of hormone therapy was also assessed and is presented for descriptive purposes.

Analytic Plan

First, I examined the sociodemographic characteristics, probable PTSD status, and health correlates of the sample, using chi-square and t-tests to compare women with elevated PTSD symptoms to those without elevated symptoms. Next, using CFA, I fit the five structural models of PTSD symptoms, with the 20 PCL-5 items treated as ordinal variables. Model fit was evaluated according to Hu and Bentler's (1999) recommended cut-offs across conventional fit statistics: Comparative Fit Index (CFI) ≥.95, Tucker Lewis Index (TLI) ≥.95, and root mean square error of approximation (RMSEA) ≤.06. To evaluate which model provided the best representation of symptom structure, I compared fit across nested models—those that use the same variables as another but with at least one additional parameter specified—with chi-square difference tests. This resulted in the following nine comparisons: hybrid model vs. the *DSM-5*, dysphoric arousal, externalizing, and anhedonia models; externalizing behaviors model vs. the *DSM-5* and dysphoric arousal models; anhedonia model vs. the *DSM-5* and dysphoric arousal models; and the dysphoric arousal model vs. the *DSM-5* model. Finally, using a latent variable framework, I examined associations of factors from the best-fitting model with correlates representing the vasomotor, urinary, and vaginal symptoms, as well as the indicator of vasomotor

symptom interference and the two measures of sexual functioning. Differences in the magnitudes of these associations across dimensions were assessed with Wald tests of parameter constraints. Analyses were completed using SPSS and the Lavaan package in R.

Sleep sensitivity analysis

Sleeping difficulties—including experiences of trauma-related nightmares and difficulty falling or staying asleep—are common predictors, consequences, and symptoms of posttraumatic psychopathology (Kobayashi, Cowdin, & Mellman, 2012; Ohayon & Shaprio, 2000), and severity of these problems are linked with greater posttraumatic stress symptom burden (Gibson, Richards et al., 2019). Sleep problems are also typical of the menopause transition (Baker et al., 2018), a time during which many women report insomnia-like sleep, with vasomotor symptom severity and nocturia frequently cited as primary contributors (Shaver & Woods, 2015).

Because of potential overlap between sleep-related PTSD symptoms and these menopause and aging-related symptoms and to minimize confounding, I conducted a sensitivity analysis where I removed the PCL-5's two sleep-related symptom indicators (item 2: repeated trauma-related nightmares; item 20: trouble falling or staying asleep) from analyses. I aimed to better determine whether associations between re-experiencing and dysphoric arousal—the larger symptom dimensions from which these sleep-specific symptoms are drawn—and the health correlates were primarily due to the sleep problems characteristic of PTSD. Should associations remain significant and at similar magnitudes, it will provide evidence suggesting that these dimensions of posttraumatic psychopathology more broadly—and not solely their components of associated sleep disturbance—are linked with menopause-related health.

After determining the best-fitting structural model of PTSD symptoms in the sample, I removed the PCL-5's two sleep-related items and replicated the appropriate CFA to re-examine

model fit. I then replicated Wald tests to investigate if similar patterns held between the emergent dimensions and correlates.

Results

Descriptive statistics

In this predominately postmenopausal sample, women were, on average, 56 years of age. As seen in Table 2, the overall sample was largely White (74%), heterosexual (75.5%), and currently or previously married (84.2%). Approximately one-half (51%) reported some college or technical education. Just over one-quarter of women (26.0%) reported elevated posttraumatic symptoms indicative of probable PTSD; these women also reported significantly shorter durations of military service relative to women without elevated PTSD symptoms. No other differences in key sociodemographic characteristics emerged based on probable PTSD status.

In the subset of women with both trauma and PTSD data (n=194), lifetime exposure to interpersonal trauma was common: 92.8% of the sample was trauma-exposed according to the study measures. Nearly three-quarters (71.6%) endorsed MST, over one-half (63.5%) reported lifetime IPV experiences, and approximately one-quarter (24.5%) endorsed experiencing IPV within the past year. There was a significant association—with a moderately-strong effect size (r=.35)—between interpersonal trauma burden and total PTSD symptoms; the greater number of interpersonal trauma exposures women reported, the higher their total PTSD symptoms.

As previously reported (Gibson & Blanken, 2022), recent experiences of menopause-related symptoms were common in this cohort; urinary, vasomotor, and vaginal symptoms were endorsed by 64.9%, 65.9%, and 57.2% of the sample, respectively (see Table 2). Over three-quarters of the sample (76.9%) endorsed clinically significant sexual distress, in the form of low sexual desire, and 16.8% reported current hormone therapy receipt. Women with probable PTSD

based on elevated symptoms were overrepresented in endorsements of urinary and vasomotor, but not vaginal, symptoms; they also endorsed greater vasomotor symptom interference. There were no differences by probable PTSD status in terms of women's sexual functioning.

Model fit comparisons

All five models provided adequate fit to the data, with CFI and TLI values indicating excellent fit (see Table 3). However, the RMSEA values for three of these models—the four-factor *DSM-5*, five-factor dysphoric arousal, and six-factor externalizing behaviors models—exceeded empirical recommendations (RMSEA $\geq$ .066), limiting goodness-of-fit. Subsequent chi-square difference tests across nested models indicated that while the externalizing behaviors model provided significantly better fit than the *DSM-5* model, $x^2(9) = 56.23$, $p<.001$, the fit of this six-factor model was not significantly better than that provided by the five-factor dysphoric arousal model, $x^2(5) = 6.26$, $p=.28$. The five-factor dysphoric arousal model did fit the data significantly better than the four-factor *DSM-5* model, $x^2(4) = 38.47$, $p<.001$.

The other two models—the seven-factor hybrid and six-factor anhedonia models—both demonstrated excellent fit to the data across all three fit indices. A series of chi-square difference tests across nested models revealed that the hybrid model provided significantly better fit to the data relative to all factor models except for the anhedonia model, $x^2(6) = 6.35$, $p=.39$. Given equivalent fit, and in the service of statistical parsimony, I proceeded with the six-factor anhedonia model as the optimal representation of PTSD in this sample (see Table 4 for factor intercorrelations). Consistent with other research on PTSD's latent structure (e.g., Sumner et al., 2014), the dimensions were highly and positively correlated with one another.

Associations between PTSD symptom dimensions and health correlates

I found evidence for associations between the six dimensions of the anhedonia model and several aspects of menopause and aging-related health and sexual dysfunction. As seen in Table 5, greater PTSD symptoms across all six dimensions were significantly associated with urinary symptom presence; correlation values ranged from .28 to .42 across the latent factors. Some differential associations also emerged: negative affect (r=.43) and dysphoric arousal (r=.42) had the strongest correlations with urinary symptoms, and the magnitudes of these associations were significantly larger than the corresponding ones for the anhedonia factor (r=.29) and, in the case of negative affect only, the avoidance dimension (r=.28). A similar picture emerged for vasomotor symptoms, in that greater PTSD symptoms across dimensions were linked both with symptom presence (rs = .24 to .38, ps$\leq$.001) and related interference (rs = .22 to .42, ps$\leq$.001). Further, the dysphoric arousal—vasomotor symptom interference associations were significantly larger than the corresponding correlations for all of the other PTSD dimensions (Table 5).

While no associations were observed between any of the dimensions and vaginal symptom presence, greater PTSD symptoms across all dimensions were linked with worse sequelae across two measures of sexual functioning (Table 5). Some differential associations across dimensions were also observed, though this varied according to the sexual functioning indicator studied. Anhedonia emerged as the dimension with the largest correlation with vaginal symptom interference on sexual functioning (r=.25); however, Wald tests revealed that the magnitude of this association was not significantly different from those of the other symptom dimensions (rs = .17-.24, ps>.05). Anhedonia was similarly relevant to low sexual desire, again emerging as the dimension with the largest correlation with this indicator (r=.34). In contrast, the association between negative affect and low sexual desire had the smallest coefficient (r=.18), and the difference in magnitude between these two dimensions was statistically significant, as

was the difference between the negative affect and re-experiencing (r=.30). No other significant differences emerged.

Sleep sensitivity analysis

Similar patterns of results were observed in the sensitivity analysis: the six-factor model fit the data well, and all factors remained significantly linked with the health correlates and at similar magnitudes (see Supplementary Table 1). Removing the two sleep-related PTSD symptoms affected the composition of the re-experiencing and dysphoric arousal dimensions. Compared to the primary analyses, associations between these two dimensions and the health correlates attenuated slightly, with the exception of the re-experiencing—urinary symptoms correlation; this correlation remained the same. Findings regarding dimensional distinctions were also largely unchanged; negative affect continued to be particularly relevant for urinary symptom presence as compared to the anhedonia and avoidance factors. Even without information about sleep disturbance, dysphoric arousal remained the dimension most strongly linked with vasomotor symptom interference.

Discussion

PTSD is heterogeneous, but its clinical manifestations and health correlates in midlife women have been under-explored. Adopting a dimensional approach may elucidate potential mechanisms driving associations between posttraumatic psychopathology and adverse health during this important time of life for women. Here, I examined the dimensional structure of PTSD symptoms in a sample of midlife women veterans—the first study to do so in this clinically complex population. I found that PTSD in this sample to be best-represented by six symptom dimensions: re-experiencing, avoidance, negative affect, anhedonia, and anxious and dysphoric arousal. Greater symptoms across these dimensions were linked with select aspects of

menopause- and aging-related health, including recent experiences of urinary and vasomotor symptoms, as well as multiple indicators of sexual dysfunction. Some associations of differential strength also emerged across the health correlates, with symptoms of negative affective and dysphoric arousal as particularly associated with menopause- and aging-related health.

Findings add to the evidence base supporting dimensional conceptualizations of posttraumatic stress. PTSD symptoms in this sample were best-characterized by the six-factor anhedonia model, rather than the hypothesized and well-supported seven-factor hybrid model, though both fit the data equally well. Indeed, all evaluated models provided adequate fit to the sample data, as is common in the PTSD CFA literature (e.g., Sumner et al., 2014; Thomas Cleveland et al., 2021). Despite equivalent fit between the six- and seven-factor models, the six-factor model was identified as optimal based on parsimony. Moreover, this model was selected by researchers as preferrable in a prior study of active duty and women veterans (Blais et al., 2018), as well as out-performed the seven-factor iteration in a separate sample of men and women veterans (Konecky et al., 2016)—highlighting convergence across military samples.

These results complement and extend prior work that has evinced associations between PTSD as a discrete diagnostic construct and menopause-related health. Indeed, similar to previous studies, I observed associations between probable PTSD status based on elevated symptomatology and both urinary (consistent with Boyd et al., 2020) and vasomotor (consistent with Gibson, Huang et al., 2019) symptoms in this sample, as well as noted associations between greater symptoms across all six posttraumatic stress dimensions and these menopause and aging-related experiences. Differential associations also emerged. In particular, the negative affect and dysphoric arousal PTSD dimensions were strongly associated with urinary symptoms, with the magnitude of these relationships significantly larger than the corresponding ones with certain

other dimensions. This suggests that these PTSD symptoms may be especially relevant for urinary health. Indeed, the strength of the associations between these dimensions and urinary symptoms may reflect women's distress regarding the functional and socioemotional impairment that can be associated with incontinence or nocturia. For example, women with urinary difficulties may experience negative thoughts and feelings—such as guilt or shame about their problems and self-blame—that influence both their PTSD symptoms and urinary problems through a negative feedback loop.

Relatedly, while greater PTSD symptoms across factors were linked both with presence of and interference of vasomotor symptoms, the dysphoric arousal dimension emerged as particularly pertinent to the reported impact of these menopause-related experiences on important life domains. In contrast to the measure of vasomotor symptom presence, the interference assessment can be conceptualized as a proxy of symptom bother, and the consistently strong associations between dysphoric arousal and reported vasomotor interference suggests that these posttraumatic stress symptoms may be particularly relevant to women's subjective experiences of this element of menopause-related health. Indeed, the symptoms characteristics of dysphoric arousal—including irritability, self-destructive and reckless behavior, and concentration and sleeping problems—may be especially heightened among women experiencing hot flashes and night sweats, for whom quality of life is typically impaired, and thereby contribute to greater perceived interference of these menopause-related experiences in daily life. Given that both dysphoric arousal and night sweats implicate sleep, I considered that the strength of this dimension-related finding might be driven by trauma-related symptoms of sleep disruption; however, dysphoric arousal remained robustly and especially linked with vasomotor symptom interference in a sensitivity analysis excluding sleep-related PTSD items—

suggesting that sleep disturbance is not the only component of this dimension that contributes strongly to menopause-related symptom interference.

Findings elucidating negative affect and dysphoric arousal as particularly important dimensions for urinary and vasomotor symptoms was somewhat, though not entirely, aligned with my hypotheses. While I did predict negative affect to be especially relevant, I also anticipated the fear-based dimensions of re-experiencing and anxious arousal to emerge as principally important, given shared pathophysiology likely common to these dimensions and menopause-related symptoms (e.g., HPA axis dysregulation; Monteleone et al., 2018). It is important to highlight that the negative affect and dysphoric arousal dimensions were more relevant for urinary and vasomotor symptom presence as compared to some, but not all, dimensions, suggesting that other aspects of PTSD may be just as pertinent to these health correlates. For example, greater symptoms across the re-experiencing and anxious arousal dimensions were linked with the urinary and vasomotor symptoms at similar magnitudes to both negative affect and dysphoric arousal, and analyses testing for significant differences in the magnitude of these associations yielded none. Thus, it may be that the fear-based PTSD symptoms are just as pertinent to these facets of menopause-related health, though future research should strive to replicate these findings.

Contrary to hypotheses, PTSD—operationalized as a diagnosis, total symptom score, and across its six dimensions—was not associated with vaginal symptoms in this sample. This finding was puzzling, as prior work conducted in a large sample midlife and older civilian women found that clinically elevated PTSD symptoms were linked with vaginal dryness and irritation, as well as pain with sex (Gibson, Huang et al., 2019)—the same indicators used in this study. This discrepancy may be due, in part, to sampling and methodological differences. For

example, the prior study operationalized PTSD according to *DSM-IV* diagnostic criteria, as well as utilized a more racially and ethnically diverse sample; further, participants were between the ages of 40-80 years. In contrast, the sample in the current report is largely White, and all women were between the ages of 45-64. I may have observed similar associations had the present sample not been truncated to this specific age range, particularly since vaginal symptoms are often more prevalent during later-life (Woods & Mitchell, 2005).

Considering PTSD as a diagnostic construct masked associations between posttraumatic psychopathology and sexual health, while dimensional operationalizations revealed links between all six dimensions and sexual functioning. Indeed, despite null findings regarding vaginal symptoms, greater PTSD symptoms across all dimensions were consistently linked with greater interference of vaginal symptoms on overall sexual functioning. It may be when it comes it comes to vaginal symptoms during midlife, co-occurring PTSD may not differentiate symptom presence so much as it does symptom impact—which is consistent with evidence that trauma-related factors are associated with menopausal symptom bother (Vegunta et al., 2016). An alternative interpretation is that those women reporting greater numbers of PTSD symptoms are also more likely to perceive and thus report symptom interference, perhaps due to overarching tendencies toward negatively-biased reporting (Aronson et al., 2006).

Greater symptoms across all six factors were also associated with low sexual desire, which is consistent with research in reproductive-aged women that has linked probable PTSD based on elevated symptoms with this aspect of sexual functioning (Bird et al., 2021). No single symptom dimension emerged as most relevant to either of these sexual health metrics. While the sexual functioning—anhedonia correlations were of the largest magnitude across indicators, differences between these correlations and those with other five factors were largely not

significant. Aligned with prior work with reproductive-aged women veterans and servicemembers (Blais et al., 2018; Schnurr et al., 2009), I had anticipated unique associations to emerge between anhedonia and dysphoric arousal symptoms and the sexual sequelae; however, relative equivalence across the six dimensions suggests that for women in midlife, multiple aspects of posttraumatic psychopathology may be pertinent to sexual functioning. Moreover, a sizable proportion of women in the current sample identified as gender and sexual minorities (e.g., queer), which may influence the types of sexual behaviors engaged in. It is possible that the sexual functioning measures here were not sensitive enough to capture activities more common in non-heterosexual-identifying individuals, which may contribute to null findings.

While the study design precludes examination of mechanisms, I hypothesize that several biological and behavioral factors may be at play. By definition, both the menopause transition and aging process involve physiological and hormonal changes that influence physical health, menopausal symptom expression, and sexual functioning, and these processes may be further affected by trauma-related inflammation or stress-induced alterations in the HPA axis. Health behaviors such as smoking, physical inactivity, and poor sleep may also play a role, as these types of behaviors have been linked both with PTSD (van den Berk-Clark et al., 2018) and risk for increased menopausal symptom bother (Anderson et al., 2020; Thurston et al., 2008). Aligned with a dimensional approach, some of these mechanisms may be especially relevant to select aspects of PTSD. For example, in this study, I found especially strong associations between negative affect and dysphoric arousal and the urinary and vasomotor symptoms; it may be that individuals high on these symptom dimensions are particularly likely to engage in select health behaviors (e.g., smoking, alcohol use, polypharmacy) to manage difficult emotions. These

behaviors could then function to perpetuate sensitivity to these menopause-related symptoms and continued psychological distress.

With regard to low sexual desire, the symptoms of emotional numbing captured by the negative affect and anhedonia factors may particularly influence interpersonal behaviors (e.g., avoiding sex, detaching from partner/spouse, expressing persistent negative feelings) in ways that result in impaired relationships with sexual partners. Relatedly, it may be that individuals high in these negative affect, anhedonia, and dysphoric arousal symptoms—transdiagnostic dimensions that collectively capture elements of dysphoria, a generalized dissatisfaction common to multiple forms of psychopathology (e.g., PTSD, depression)—are more likely to engage in more sedentary behavior, a correlate of PTSD and one that has been linked both with more severe menopausal symptoms (Blümel et al., 2016) and low sexual desire (Esfahani & Pal, 2018). While these are mere hypotheses, findings from this study may pave the way for more precise examinations of mechanisms linking PTSD dimensions with menopause and aging-related health. Future research should strive to disentangle these complex and likely interacting pathways through longitudinal designs that include repeated measures of posttraumatic psychopathology symptoms, candidate biological and psychosocial mechanisms, and the menopause and aging-related symptoms and sexual health metrics.

To my knowledge, this is the first study to adopt a dimensional approach to the study of PTSD and menopause and aging-related health. I examined these associations in a sample of midlife women veterans, who constitute nearly half of the women-identifying individuals served by the VHA (Frayne et al., 2018) and thereby represent a critical target population that could be easily served within this integrated healthcare system. Moreover, findings add to the limited literature assessing trauma, PTSD, and health in women past reproductive age. I also extend the

prior literature examining posttraumatic stress and adverse sexual health in women—both those who are reproductive-aged (Kolaja, Schuyler et al., 2021) and those in midlife (Gibson, Huang et al., 2019)—by employing standardized measures of sexual health with good psychometric properties. Prior work in this area has primarily relied on single-item indicators of sexual difficulties; in this study, I include both similar assessments (e.g., vaginal symptom presence) and standardized assessments with demonstrated reliability and validity, thereby strengthening confidence in yielded results.

Study limitations include the cross-sectional research design and the self-reported nature of all data, which precludes conclusions regarding causality and may inflate associations due to shared method variance, respectively. While self-report research can introduce bias, it also has the potential to shed light on sensitive and stigmatized topics that may be underreported in healthcare settings. Indeed, prior research in this sample found that nearly 60% of women veterans without chart-documented MST disclosed the experience by survey (Hargrave et al., 2022), highlighting the value of participant self-report. In this study, a comprehensive trauma battery was not administered, and PTSD symptoms were not anchored to a specific traumatic event; while this is not the gold standard PTSD assessment, rating symptoms without a Criterion A is common in the PCL-5 literature (Forkus et al., 2023). Moreover, there was a positive, moderate-to-strong correlation between interpersonal trauma burden and total PTSD symptom severity in this sample, suggesting that the measure was capturing true trauma-related sequelae. A related measurement limitation is that while the PCL-5 queried past-month PTSD symptoms, some of the menopause-related symptom assessments—specifically, the measure of urinary incontinence—assessed experiences over the past three months; thus, it is possible that women experienced leakage prior to, and not concurrent with, posttraumatic psychopathology. Data on

use of psychiatric medications were also not available, an important constraint given that select antidepressant medications are often prescribed to treat PTSD and have been shown to negatively impact sexual desire (Lorenz, Rullo, & Faubion, 2016). Finally, the sample was relatively homogenous, thus limiting the potential to examine differences across sociodemographic or clinical groupings. Future research should aim to examine how these associations between PTSD symptom dimensions and menopause-related health vary by race and ethnicity, given evidence for disparities in both menopause symptom reporting (Blanken et al., 2022) and across PTSD symptom dimensions (Thomas, Carter et al., 2021), and in larger, more demographically representative samples.

Larger sample sizes may also facilitate more nuanced investigations of how select posttraumatic stress symptoms may be linked with menopause-related symptom bother and severity, in order to better understand how to help the women most impacted by these experiences. Indeed, in the present sample, cell sizes for women reporting bothersome urinary, vasomotor, and/or vaginal symptoms were small, ranging from 40 to 89 across the discrete symptom sets; thus, menopause-related symptom prevalence, for which the sample sizes were larger, was utilized as the metric of health. Future research could also employ objective assessments of PTSD dimensions, such as assessments of fear-based dimensions through fear conditioning paradigms (Briscione, Jovanovic, & Norrholm, 2014) and attention allocation tasks for dysphoria/negative affect (Lazarov et al., 2018; Powers et al., 2019). Incorporating these assessment measures would bolster confidence in findings, in that they could address concerns that the associations detected herein reflect common method variance.

Limitations notwithstanding, these findings have important clinical implications. Given clear associations between trauma, PTSD, and menopausal health, I echo the call (Gibson,

Huang et al., 2019; Raphael et al., 2022) for routine screening of trauma history and posttraumatic psychopathology symptoms in women during menopause-related healthcare consultations. Current clinical recommendations emphasize screening for past-year experiences of physical intimate partner violence in reproductive-aged women (US Preventive Services Task Force, 2018) and for depressive and anxiety symptoms during the perinatal period (American College of Obstetricians and Gynecologists, 2018). Similar guidelines for screening for trauma and related psychopathology in midlife women are noticeably lacking, despite growing acknowledgement of both the prevalence and health-related implications of these exposures (Cook, 2022; Cook, Dinnen, & O'Donnell, 2011). Indeed, one recent analysis of over 33,000 midlife and older women found that one-third of women with a lifetime history of PTSD never received trauma-related treatment (Sampson et al., 2022), highlighting the unmet detection of trauma-related concerns in this population. In addition to broadly screening for trauma-related experiences, the findings from this study suggest that screening for select PTSD symptoms—specifically, negative affect and dysphoric arousal—may help identify the aging women at greatest risk for potentially interfering menopause symptoms, namely urinary problems, hot flashes, and night sweats. These specific PTSD symptoms capture elements of generalized dysphoria, rather than trauma-specific fear, and may especially shape women's experiences of menopausal symptom severity and associated disruption. Implementing PTSD symptom screening in healthcare settings that serve midlife and older women may aid in connecting those at-risk with appropriate care to manage both their trauma-related mental health difficulties and menopause-related health.

Conclusions

Most research on PTSD and women's health focuses on those who are reproductive-aged. These findings add to the small, but growing, evidence base examining trauma, PTSD, and health in midlife women, with a focus on menopause and aging-related symptoms and sexual health. In this cohort of midlife women veterans, PTSD symptoms were best characterized by six discrete factors. Greater symptoms across the six dimensions were linked with urinary and vasomotor, but not vaginal, symptoms; vasomotor symptom interference; and sexual dysfunction. While negative affect and dysphoric arousal were particularly related to urinary and vasomotor symptoms, limited dimensional distinctions emerged for sexual health, suggesting that posttraumatic psychopathology broadly is relevant to sexual functioning during this time. Future research is needed to ascertain whether intervening on specific PTSD dimensions could alleviate associated menopause- and aging-related health concerns, thereby improving midlife women's health.

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Table 1. Item Mappings of *DSM-5* PTSD Symptoms Across Dimensional Models

***DSM-5* Symptom**	**DSM-5**	**Dysphoric Arousal**	**Externalizing Behaviors**	**Anhedonia**	**Hybrid**
1. Intrusive thoughts	R	R	R	R	R
2. Nightmares	R	R	R	R	R
3. Flashbacks	R	R	R	R	R
4. Emotional cue reactivity	R	R	R	R	R
5. Physiological cue reactivity	R	R	R	R	R
6. Avoidance of thoughts	A	A	A	A	A
7. Avoidance of reminders	A	A	A	A	A
8. Trauma-related amnesia	NACM	NACM	NACM	NA	NA
9. Negative beliefs	NACM	NACM	NACM	NA	NA
10. Blame self or others	NACM	NACM	NACM	NA	NA
11. Negative trauma-related emotions	NACM	NACM	NACM	NA	NA
12. Loss of interest	NACM	NACM	NACM	An	An
13. Detachment	NACM	NACM	NACM	An	An
14. Restricted affect	NACM	NACM	NACM	An	An
15. Irritability/anger	AR	DA	EB	DA	EB
16. Self-destructive/reckless behavior	AR	DA	EB	DA	EB
17. Hypervigilance	AR	AA	AA	AA	AA
18. Exaggerated startle response	AR	AA	AA	AA	AA
19. Difficulty concentrating	AR	DA	DA	DA	DA
20. Sleep disturbance	AR	DA	DA	DA	DA

Note. R = re-experiencing; A = avoidance; NACM = negative alterations in cognition and mood; AR = alterations in arousal and reactivity; NA = negative affect; An = anhedonia; EB = externalizing behaviors; AA = anxious arousal; DA = dysphoric arousal

Table 2. Participant Characteristics (*N*=208)

	Full Sample (*N*=208) M (SD) or % (*N*)	**Women with Elevated PTSD Symptoms (*n*=54)**	**Women without Elevated PTSD Symptoms (*n*=154)**	***p*-value**
Sociodemographic and clinical data				
Age	55.71 (5.12)	55.58 (4.33)	55.75 (5.38)	.82
Race/ethnicity				.68
White	74.0 (154)	79.6 (43)	72.1 (111)	
Black or African American	9.1 (19)	7.4 (4)	9.7 (15)	
Asian	3.8 (8)	1.9 (1)	4.5 (7)	
Multiracial/other	13.0 (27)	11.1 (6)	13.6 (21)	
Hispanic or Latina	11.1 (23)	9.3 (5)	11.7 (18)	.74
Education				.36
Some college or less	51.0 (106)	59.3 (32)	48.1 (74)	.36
College degree	14.4 (30)	11.1 (6)	15.6 (24)	
Some graduate school or degree	34.6 (72)	29.6 (16)	36.4 (56)	
Marital status				.39
Single/never married	13.5 (28)	18.5 (10)	11.7 (18)	
Divorced or separated	40.9 (85)	42.6 (23)	40.3 (62)	
Married/living as married	43.3 (98)	35.2 (19)	46.1 (71)	
Widowed	2.4 (5)	3.7 (2)	1.9 (3)	
Sexual orientation				.261
Straight or heterosexual	75.5 (157)	70.3 (38)	77.3 (119)	
Lesbian, gay, or homosexual	14.4 (30)	13.0 (7)	14.9 (23)	
Bisexual	6.3 (13)	11.1 (6)	4.5 (7)	
Other	2.9 (6)	3.7 (2)	2.6 (4)	
Military service duration	8.83 (8.38)	6.5 (6.5)	9.6 (8.8)	.004
Menopause status				.38
Perimenopausal/unclear	18.3 (38)	22.2 (12)	16.9 (26)	
Postmenopausal	81.7 (170)	77.8 (42)	83.1 (128)	
Current hormone therapy receipt	16.8 (35)	16.7 (9)	16.9 (26)	.97
Menopause and aging-related correlates				
Urinary symptoms	64.9 (135)	81.5 (44)	59.1 (91)	.003
Vasomotor symptoms	65.9 (137)	81.5 (44)	60.4 (93)	.005
Vasomotor symptom interference	24.98 (21.70)	26.12 (25.87)	14.23 (18.90)	.003
Vaginal symptoms	57.2 (119)	61.1 (33)	55.8 (86)	.75
Sexual dysfunction				
Day-to-day impact of vaginal aging on sexual functioning	1.04 (1.15)	1.29 (1.26)	.95 (1.11)	.07
Low sexual desire	76.9 (160)	75.5 (40)	79.5 (120)	.54

Table 3. Fit Statistics for Confirmatory Factor Analyses

Model	x^2	**df**	**CFI**	**TLI**	**RMSEA [90% CI]**
DSM-5 Model	355.560*	164	0.983	0.980	0.075 (0.022, 0.064)
Dysphoric Arousal Model	302.704*	160	0.987	0.985	0.066 (0.054, 0.077)
Externalizing Behaviors Model	297.933*	155	0.987	0.984	0.067 (0.055, 0.078)
Anhedonia Model	234.972*	155	0.993	0.991	0.050 (0.036, 0.062)
Hybrid Model	229.071*	149	0.993	0.991	0.051 (0.037, 0.064)

Note. df = degrees of freedom; CFI = Comparative Fit Index; TLI = Tucker Lewis Index; RMSEA = root mean square error of approximation; CI = confidence interval

*p<.001

Table 4. Intercorrelations Between Six Factors of the Anhedonia Model

	1.	**2.**	**3.**	**4.**	**5.**	**6.**
1. Re-experiencing	—					
2. Avoidance	.91	—				
3. Negative affect	.90	.85	—			
4. Anhedonia	.80	.78	.89	—		
5. Dysphoric arousal	.86	.80	.93	.95	—	
6. Anxious arousal	.82	.77	.79	.78	.86	—

Note. All *p*s < .0001

Table 5. Wald Tests of Parameter Constraints for Comparisons of Correlations Between Factors with the Menopause and Aging-Related Correlates and Sexual Functioning Metrics

	Correlation		Correlation	Wald test statistic	*p*-value
Menopause and aging-related correlates					
Urinary symptoms					
Re-experiencing	.33***	Avoidance	.28**	0.97	.32
Re-experiencing	.33***	NA	.43***	2.68	.10
Re-experiencing	.33***	Anhedonia	.29**	0.37	.54
Re-experiencing	.33***	Anxious Arousal	.38***	0.67	.41
Re-experiencing	.33***	Dysphoric Arousal	.42***	1.51	.22
Avoidance	.28**	NA	.43***	5.17	**.02**
Avoidance	.28**	Anhedonia	.29**	0.01	.92
Avoidance	.28**	Anxious Arousal	.38***	2.09	.15
Avoidance	.28**	Dysphoric Arousal	.42***	3.37	.07
NA	.43***	Anhedonia	.29**	4.38	**.04**
NA	.43***	Anxious Arousal	.38***	0.32	.57
NA	.43***	Dysphoric Arousal	.42***	0.01	.93
Anhedonia	.29**	Anxious Arousal	.38***	1.54	.21
Anhedonia	.29**	Dysphoric Arousal	.42***	4.67	**.03**
Anxious Arousal	.38***	Dysphoric Arousal	.42***	0.23	.63
Vasomotor symptoms					
Re-experiencing	.34***	Avoidance	.34***	0.01	.90
Re-experiencing	.34***	NA	.31***	0.21	.65
Re-experiencing	.34***	Anhedonia	.24**	2.16	.14
Re-experiencing	.34***	Anxious Arousal	.33***	0.01	.90
Re-experiencing	.34***	Dysphoric Arousal	.38***	0.52	.47
Avoidance	.34***	NA	.31***	0.27	.60
Avoidance	.34***	Anhedonia	.24**	2.27	.13
Avoidance	.34***	Anxious Arousal	.33***	0.04	.84
Avoidance	.34***	Dysphoric Arousal	.38***	0.38	.54
NA	.31***	Anhedonia	.24**	1.83	.18
NA	.31***	Anxious Arousal	.33***	0.06	.80
NA	.31***	Dysphoric Arousal	.38***	1.52	.22
Anhedonia	.24**	Anxious Arousal	.33***	1.60	.21
Anhedonia	.24**	Dysphoric Arousal	.38***	6.38	**.01**
Anxious Arousal	.33***	Dysphoric Arousal	.38***	0.69	.41
Vasomotor symptom interference					
Re-experiencing	.29***	Avoidance	.26**	0.52	.47
Re-experiencing	.29***	NA	.22**	2.62	.11
Re-experiencing	.29***	Anhedonia	.30***	0.06	.81
Re-experiencing	.29***	Anxious Arousal	.28***	0.02	.89
Re-experiencing	.29***	Dysphoric Arousal	.42***	5.32	**.02**
Avoidance	.26**	NA	.22**	0.59	.44
Avoidance	.26**	Anhedonia	.30***	0.75	.39
Avoidance	.26**	Anxious Arousal	.28***	0.11	.74
Avoidance	.26**	Dysphoric Arousal	.42***	6.68	**.01**
NA	.22**	Anhedonia	.30***	2.62	.11
NA	.22**	Anxious Arousal	.28***	0.72	.40
NA	.22**	Dysphoric Arousal	.42***	12.17	**<.001**
Anhedonia	.30***	Anxious Arousal	.28***	0.10	.76
Anhedonia	.30***	Dysphoric Arousal	.42***	5.50	**.02**
Anxious Arousal	.28***	Dysphoric Arousal	.42***	4.76	**.03**
Vaginal symptoms					
Re-experiencing	.08	Avoidance	.01	1.46	.23
Re-experiencing	.08	NA	.07	0.02	.88

Re-experiencing	.08	Anhedonia	.05	0.17	.68
Re-experiencing	.08	Anxious Arousal	.19	1.77	.18
Re-experiencing	.08	Dysphoric Arousal	.14	0.56	.45
Avoidance	.01	NA	.07	0.90	.34
Avoidance	.01	Anhedonia	.05	0.29	.59
Avoidance	.01	Anxious Arousal	.19	4.38	**.04**
Avoidance	.01	Dysphoric Arousal	.14	2.42	.12
NA	.07	Anhedonia	.05	0.10	.75
NA	.07	Anxious Arousal	.19	2.20	.14
NA	.07	Dysphoric Arousal	.14	0.82	.36
Anhedonia	.05	Anxious Arousal	.19	3.29	.07
Anhedonia	.05	Dysphoric Arousal	.14	2.03	.15
Anxious Arousal	.19	Dysphoric Arousal	.14	0.44	.51
Sexual dysfunction					
Day-to-day impact of vaginal aging on sexual functioning					
Re-experiencing	.20**	Avoidance	.17*	0.53	.47
Re-experiencing	.20**	NA	.24***	0.62	.43
Re-experiencing	.20**	Anhedonia	.25**	0.63	.43
Re-experiencing	.20**	Anxious Arousal	.17*	0.33	.56
Re-experiencing	.20**	Dysphoric Arousal	.23**	0.28	.59
Avoidance	.17*	NA	.24***	1.60	.21
Avoidance	.17*	Anhedonia	.25**	1.50	.22
Avoidance	.17*	Anxious Arousal	.17*	1.61	1.00
Avoidance	.17*	Dysphoric Arousal	.23**	0.98	.32
NA	.24***	Anhedonia	.25**	0.03	.87
NA	.24***	Anxious Arousal	.17*	1.16	.28
NA	.24***	Dysphoric Arousal	.23**	0.05	.83
Anhedonia	.25**	Anxious Arousal	.17*	1.11	.29
Anhedonia	.25**	Dysphoric Arousal	.23**	0.16	.69
Anxious Arousal	.17*	Dysphoric Arousal	.23**	0.99	.32
Low sexual desire					
Re-experiencing	.30***	Avoidance	.22**	3.02	.08
Re-experiencing	.30***	NA	.18*	5.86	**.02**
Re-experiencing	.30***	Anhedonia	.34***	0.36	.55
Re-experiencing	.30***	Anxious Arousal	.30***	0.01	.94
Re-experiencing	.30***	Dysphoric Arousal	.24**	0.96	.33
Avoidance	.22**	NA	.18*	0.48	.49
Avoidance	.22**	Anhedonia	.34***	3.38	.07
Avoidance	.22**	Anxious Arousal	.30***	1.42	.23
Avoidance	.22**	Dysphoric Arousal	.24**	0.10	.75
NA	.18*	Anhedonia	.34***	7.05	**.01**
NA	.18*	Anxious Arousal	.30***	3.03	.08
NA	.18*	Dysphoric Arousal	.24**	0.95	.33
Anhedonia	.34***	Anxious Arousal	.30***	0.39	.53
Anhedonia	.34***	Dysphoric Arousal	.24**	2.69	.10
Anxious Arousal	.30***	Dysphoric Arousal	.24**	0.89	.34

Note. ***$p \leq .001$ ** $p \leq .01$ *$p \leq .05$

Supplementary Table 1. Wald Tests of Parameter Constraints for Comparisons of Correlations Between Factors that Exclude Sleep-Related PTSD Symptoms with the Menopause and Aging-Related Correlates

	Correlation		Correlation	Wald test statistic	*p*-value
Urinary symptoms					
Re-experiencing	.33***	Avoidance	.28**	0.85	.36
Re-experiencing	.33***	NA	.43***	2.93	.09
Re-experiencing	.33***	Anhedonia	.29**	0.32	.57
Re-experiencing	.33***	Anxious Arousal	.38***	0.74	.39
Re-experiencing	.33***	Dysphoric Arousal	.40***	0.79	.37
Avoidance	.28**	NA	.43***	5.18	**.02**
Avoidance	.28**	Anhedonia	.29**	0.01	.92
Avoidance	.28**	Anxious Arousal	.38***	2.08	.15
Avoidance	.28**	Dysphoric Arousal	.40***	2.93	.09
NA	.43***	Anhedonia	.29**	4.34	**.04**
NA	.43***	Anxious Arousal	.38***	0.32	.57
NA	.43***	Dysphoric Arousal	.40***	0.22	.64
Anhedonia	.29**	Anxious Arousal	.38***	1.54	.21
Anhedonia	.29**	Dysphoric Arousal	.40***	2.87	.09
Anxious Arousal	.38***	Dysphoric Arousal	.40***	0.02	.89
Vasomotor symptoms					
Re-experiencing	.33***	Avoidance	.34***	2.87	.09
Re-experiencing	.33***	NA	.31***	0.15	.69
Re-experiencing	.33***	Anhedonia	.24**	2.04	.15
Re-experiencing	.33***	Anxious Arousal	.33***	0.01	.94
Re-experiencing	.33***	Dysphoric Arousal	.30***	0.22	.64
Avoidance	.34***	NA	.31***	0.01	.94
Avoidance	.34***	Anhedonia	.24**	2.27	.13
Avoidance	.34***	Anxious Arousal	.33***	0.04	.84
Avoidance	.34***	Dysphoric Arousal	.30***	0.33	.57
NA	.31***	Anhedonia	.24**	1.84	.18
NA	.31***	Anxious Arousal	.33***	0.06	.80
NA	.31***	Dysphoric Arousal	.30***	0.04	.84
Anhedonia	.24**	Anxious Arousal	.33***	1.60	.21
Anhedonia	.24**	Dysphoric Arousal	.30***	0.98	.32
Anxious Arousal	.33***	Dysphoric Arousal	.30***	0.17	.68
Vasomotor symptom interference					
Re-experiencing	.28***	Avoidance	.26**	0.26	.61
Re-experiencing	.28***	NA	.22**	1.99	.16
Re-experiencing	.28***	Anhedonia	.30***	0.18	.67
Re-experiencing	.28***	Anxious Arousal	.28***	0.0007	.98
Re-experiencing	.28***	Dysphoric Arousal	.40***	4.38	**.04**
Avoidance	.26**	NA	.22**	0.59	.44
Avoidance	.26**	Anhedonia	.30***	0.75	.39
Avoidance	.26**	Anxious Arousal	.28***	0.11	.73
Avoidance	.26**	Dysphoric Arousal	.40***	5.21	**.02**
NA	.22**	Anhedonia	.30***	2.61	.11
NA	.22**	Anxious Arousal	.28***	0.72	.40
NA	.22**	Dysphoric Arousal	.40***	10.72	**.001**
Anhedonia	.30***	Anxious Arousal	.28***	0.09	.76
Anhedonia	.30***	Dysphoric Arousal	.40***	3.83	**.05**
Anxious Arousal	.28***	Dysphoric Arousal	.40***	3.50	.06

Note. ***$p \leq .001$ ** $p \leq .01$ *$p \leq .05$