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How Does Childhood Trauma Impact Women's Sexual Desire? Role of Depression, Stress, and Cortisol

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ABSTRACT

The relationship between childhood trauma and adult sexual dysfunction is well documented; however, there is a paucity of research that examines the physiological and psychological mechanisms that may potentiate this relationship. As depression, perceived stress, and hypothalamic pituitary adrenal (HPA) axis dysregulation are correlates of childhood trauma and sexual dysfunction, the current study sought to examine the association of each of these domains with low sexual desire in a sample of (N = 275 [n = 137 women with low sexual desire; n = 138 sexually healthy women]) non-clinically depressed women. First, we assessed the relative contributions of HPA axis dysregulation (as indexed by the diurnal cortisol slope), childhood trauma, depression symptoms and perceived daily stress on low sexual desire. Next, we examined the degree to which HPA axis dysregulation, perceived stress, and depressive symptoms, respectively, mediated the relationship between childhood trauma and sexual desire. Results indicate that diurnal cortisol slope and depression symptoms contribute to low desire over and above perceived stress and childhood trauma and that childhood trauma is associated with low sexual desire predominantly through depressive symptomatology. Theoretical and clinical implications of the findings are discussed.

According to the World Health Organization (WHO), a quarter of all adults worldwide report a history of having been physically abused as children, whereas 1 in 5 women and 1 in 13 men report childhood sexual abuse (CSA). Additionally, many children are subject to emotional/psychological abuse and to neglect (World Health Organization, 2018). Given that the childhood years are a critical period of psychosexual development, there has been much interest in the impact of early life abuse, trauma, and adversity on adult sexual functioning. Childhood abuse and/or traumatic experiences have a damaging effect on the development of social growth, sexual response, and interpersonal functioning in adulthood (Maltz, 2002), which affect not only fear of intimacy (De Silva, 2001; Maltz, 2002), but also directly impact adult sexual functioning (Najman, Dunne, Purdie, Boyle, & Coxeter, 2005). Despite the unfortunately common prevalence of childhood adversities among women seeking therapy for sexual dysfunction, the field lacks adequate information with respect to the key psychological factors that affect the sexual lives of victims and the main targets to address in therapy. Indeed, we have yet to identify whether it is more effective to focus on lasting changes from the past experiences on current sexual schemas/beliefs, or shift the focus on current depressive symptoms or daily stressors.

The relationship between childhood adversities and adult sexual dysfunction is well documented in the literature. For example, more than half of women (56%) and more than a third of men (37%) seeking sex therapy also report having experienced CSA (Berthelot, Godbout, Hébert, Goulet, & Bergeron, 2014). Importantly, however, not all individuals who have experienced CSA have poorer sexual functioning in adulthood. Even those that do experience negative sexual sequelae as a result of CSA demonstrate a range of functioning. Thus, there is a need to identify the potential mechanisms that may underlie, or mediate, the relationship between childhood traumatic experiences and adult sexual functioning, the former of which we are herein defining as the self-report of emotional, physical, and/or sexual abuse, and/or emotional or physical neglect.

When considering potential physiological mechanisms that can explain the relationship between childhood trauma and adult sexual dysfunction, mounting evidence points to the hypothalamic-pituitary-adrenal (HPA) axis as a mediator. Psychological mechanisms that may provide an additive explanation to the development of sexual dysfunction in adults who suffered childhood trauma include depression and daily stress. These psychological processes are particularly interesting not only because they are correlates of childhood trauma (Vranceanu, Hobfoll, & Johnson, 2007) and sexual dysfunction (Atlantis & Sullivan, 2012; Hamilton & Meston, 2013), but also because they have empirical and theoretical links to HPA axis functioning (Heim & Nemeroff, 2001). Despite indications of a correlational relationship between sexual dysfunction, childhood trauma, daily stress, HPA axis

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dysregulation, and depression, little is known about the relative contributions of each of these domains to common sexual difficulties—such as low sexual desire. A clearer understanding of this relationship has both theoretical and clinical implications and may identify points of intervention for women presenting with comorbid sexual dysfunction, childhood traumatic experiences, significant stress, and depression.

Childhood Trauma, Stress, and Sexual Functioning

The correlation between sexual dysfunction and childhood trauma – particularly sexual trauma – has been documented in epidemiological, cross-sectional, and longitudinal studies over the past several decades. Although the results are not always consistent, a review of 38 studies reported that, across methodologies, samples, and measures, childhood traumatic experiences are clear risk factors for adult sexual dysfunction (Neumann, Houskamp, Pollock, & Briere, 1996). The inconsistency may be pointing to a complex relationship mediated by a number of factors that have yet to be clearly defined. In general, studies that recruited participants from the college population tend to find smaller or non-significant effects in the relationship between childhood trauma and sexual function, while studies recruiting adult women from the community with more severe forms of childhood maltreatment and abuse tend to show more robust differences (Rellini, 2008). This finding may be an artifact of a dose–response relationship between the frequency of childhood traumatic experiences and general health problems in adulthood (Edwards, Holden, Felitti, & Anda, 2003). Among the different types of sexual dysfunction, lower levels of sexual desire, problems becoming sexually aroused, and difficulty reaching orgasm are most often reported by women who have experienced childhood maltreatment (Rellini, 2005).

The Role of the Hypothalamic Pituitary Adrenal (HPA) Axis

One likely, but understudied, physiological mechanism underlying sexual dysfunction in adults with a history of childhood trauma is the HPA axis – the main system responsible for the stress response (King, Mandansky, King, Fletcher, & Brewer, 2001). During early life, the HPA axis is highly plastic (Gunnar & Vazquez, 2006), and thus, susceptible to long-term dysregulation from the alterations that occur when acutely stressful circumstances are experienced. The effects of childhood trauma on HPA axis functioning may reach maximum levels during adulthood (Bunea, Szentágotai-Tătar, & Miu, 2017). For example, in a longitudinal study of women reporting CSA, the trend in cortisol attenuation in individuals reporting childhood trauma appeared to be nonlinear, such that it was significantly less steep during developmental ages compared to that of early adulthood (Trickett, Noll, Susman, Shenk, & Putnam, 2010). In the context of sexual functioning, alterations to cortisol secretion, the end-product of the HPA axis, are particularly relevant, as cortisol has been implicated in sexual motivation and response (for reviews see Hamilton, Rellini, & Meston, 2008; Sapolsky, Romero, & Munck, 2000). Different patterns of altered cortisol secretion have been observed in individuals with a history of childhood trauma, including hypocortisolism (Heim, Newport, Bonsall, Miller, & Nemeroff, 2001; Trickett et al., 2010; Yehuda, Halligan, & Grossman, 2001) and hypercortisolism (Cicchetti & Rogosch, 2001), as well as a flatter diurnal cortisol slope (Cicchetti & Rogosch, 2001; Kuras et al., 2017; Weissbecker, Floyd, Dedert, Salmon, & Sephton, 2006). The latter, representing a change in the natural circadian rhythm of cortisol secretion (van der Vegt, Van Der Ende, Kirschbaum, Verhulst, & Tiemeier, 2009), indicates a deviation from the typical cortisol pattern – high upon waking, surging 30–40 min after waking, dropping rapidly in the few hours after waking, and finally, dropping slowly throughout the remainder of the day (Adam & Kumari, 2009). A disruption in cortisol's natural rhythm so too disrupts its regulatory functions, resulting in a variety of negative physical and mental health outcomes (Adam et al., 2017). This may be particularly relevant to sexual functioning as recent research has pointed to a flatter diurnal cortisol slope in women with hypoactive sexual desire disorder (HSDD) in comparison to sexually healthy women (Basson et al., 2019).

The lives of women who survived childhood traumatic experiences are complex and often include current, in addition to past stressors, which may affect sexual desire. Specifically, women with a history of childhood traumatic experiences report greater negative affectivity, the tendency to worry about general stressors (Scarpa, Wilson, Wells, Patriquin, & Tanaka, 2009), and greater sensitivity to stressors (Hammen, Henry, & Daley, 2000; Scarpa et al., 2009). These findings may be explained by the fact that a history of childhood trauma may result in allostatic overload – the wear and tear on the body and brain that results from the cumulative effects of chronic stress (McEwen, 2005). A history of childhood trauma may also lead to underdeveloped stress coping skills (McCrory, De Brito, & Viding, 2010), thereby impairing the ability to react in effective ways to daily stressors (Zollman, Rellini, & Desrocher, 2013). This is highly relevant to sexual functioning, as there is increasing empirical support for the negative effects of chronic stress, including daily hassles, on sexual function (Hamilton & Julian, 2014; Hamilton & Meston, 2013). Indeed, in women, chronic daily stressors were found to have a stronger association with psychological symptoms and negative affect than the effects of a single traumatic event (Kanner, Coyne, Schaefer, & Lazarus, 1981). Moreover, chronic daily stress has been shown to mediate the relationship between chronic events and negative psychological outcomes, highlighting the important but overlooked role of daily stress on psychological well-being (Aldwin, Jeong, Igarashi, & Spiro, 2014). Further, studies report that daily stress is significantly correlated with lower marital quality and decreased marital functioning (Harper, Schaalje, & Sandberg, 2000; Neff & Broady, 2011), which can impact sexual function (Byers, 2005), particularly sexual desire (Brezsnyak & Whisman, 2004). Stemming from these findings and others that document the effects of stress on sexual functioning in women (e.g., Brotto et al., 2016), when making a diagnosis of a sexual desire disorder, the effects of significant stress have been deemed necessary to be taken into account (American Psychiatric Association [APA], 2013).

Childhood Trauma, Depression, and Sexual Functioning

Of note, not all people who experience childhood trauma also experience sexual dysfunction in their adult life (e.g., Berthelot et al., 2014). Depression is one factor that may potentiate the relationship between childhood trauma and sexual difficulties, as depression is commonly comorbid with both childhood traumatic experiences (Heim, Newport, Mletzko, Miller, & Nemeroff, 2008) and sexual difficulties (Cyranowski et al., 2004). Indeed, in a recent study, approximately 76% of the chronically depressed adults in the sample retrospectively recalled childhood traumatic events (Negele, Kaufhold, Kallenbach, & Leuzinger-Bohleber, 2015), and, in a representative sample of adults from the United States, the odds ratios for individuals with a history of childhood neglect or abuse to have major depression were between 3.0 and 4.2 (Taillieu, Brownridge, Sareen, & Afifi, 2016). Likewise, there has long been recognition of the association between depressive symptoms and sexual difficulties—low sexual desire in particular (Cyranowski et al., 2004; Zajecka et al., 2002). A large number of studies have documented an association between depressed mood and sexual dysfunction, suggesting a bidirectional relationship between these domains. For example, a meta-analysis of 14,000 participants, followed longitudinally, showed that those with a history of depression had a 50–70% increased risk of developing a sexual dysfunction, and those with a sexual dysfunction had a 130–210% increased risk of developing depression (Atlantis & Sullivan, 2012). Additionally, changes in depression symptom severity have been shown to correspond to same-day variations in sexual response (Kalmbach, Kingsberg, & Ciesla, 2014). Specifically, anhedonia appears to be related to same-day and next day decreases in sexual desire, whereas general distress appears to impact orgasmic function.

In sum, the literature points to an intricate relationship between the HPA axis and the other potential risk factors (i.e., daily stress and depression) for low sexual desire in women with a history of childhood trauma. This complicates our understanding of the independent role of each predictor on sexual desire. As reviewed in the literature, childhood trauma has been associated with impairment in the HPA axis (see Shea, Walsh, MacMillan, & Steiner, 2005 for a review). Additionally, studies have found an association between HPA axis impairments and depressive symptoms (Pariante & Lightman, 2008), daily stress (Miller, Cohen, & Ritchey, 2002), and sexual desire (Basson et al., 2019), respectively. Understanding whether any of these factors provide an independent contribution to the variance in sexual desire can be useful in our attempt to distinguish potential target variables for therapy specific to women with a history of childhood trauma.

The Present Study

The primary objective of the present study was to assess the relative contributions of HPA axis dysregulation (as indexed by the diurnal cortisol slope), childhood trauma, depression symptoms, and perceived daily stress on sexual functioning (as indexed by sexual desire) in a sample of non-clinically depressed women. Sexual functioning was indexed as sexual desire on the basis that low sexual desire is the most frequently reported sexual health concern in women (Mitchell et al., 2013; Shifren, Monz, Russo, Segreti, & Johannes, 2008). HPA axis function was indexed as diurnal cortisol slope (the difference in cortisol levels from morning to evening) on the basis that a flattened diurnal cortisol slope is one of the most consistent markers of HPA axis dysfunction (Adam & Kumari, 2009) and has been linked to low sexual desire when measured categorically and continuously (Basson et al., 2019).

We hypothesized that childhood trauma, perceived daily stress, and depression symptoms would be stronger predictors of sexual desire (measured categorically as HSDD[1] diagnosis vs. sexually healthy) than HPA axis dysregulation alone. Additionally, we explored the degree to which depression symptoms, diurnal cortisol slope, and perceived stress, respectively, mediate the relationship between childhood trauma and sexual desire.

Method

Participants

Inclusion criteria for participation in the current study included being a woman between the ages of 19 and 65, with no current major medical illnesses known to impact sexual functioning, no current diagnosis of clinical depression, and no use of medications with known side-effects on sexual functioning (e.g., antidepressants or hormone therapy). Women meeting criteria for moderate to severe clinical depression were excluded from the study due to the possibility that a lack of desire could be primarily a manifestation of a general lack of motivation to engage in rewarding experiences, a characteristic of depression which may obfuscate problems specific with sexual desire. Participants were excluded if they were smokers or drug users, if they experienced pain during penetrative sex that was not relieved by an external lubricant, if low sexual desire was mostly attributed to relationship conflict, or if low desire had been present for less than 1 year. Due to the possible impact of body mass index on serum cortisol levels (Odeniyi, Fasanmade, Ogbera, & Ohwovoriole, 2015), participants were also required to have a body mass index of more than 18.5 and less than 29.9.

Participant recruitment was conducted via posting advertisements online (i.e., Craigslist, university paid studies list, hospital research institute list-serves), in local newspapers, and on flyers throughout the community. We also informed primary care providers accepting patients with sexual health concerns about the study and posted an advertisement in their clinics if permission to do so was received.

Women who responded to advertisements were screened over the phone by a trained research assistant to assess for operational HSDD criteria (i.e., lack of sexual desire for a minimum of 1 year that caused significant personal and/or

[1]Data collection for the current study began in 2011, prior to the introduction of the DSM 5 in which HSDD was replaced with Sexual Interest/Arousal Disorder (SIAD).

interpersonal distress). Of the 856 women that expressed interest in the study, 464 were either ineligible (n = 354), or, when contacted, no longer wished to participate in the study (n = 110). Medication use was the most common reason potential participants were excluded from the study (n = 39). Of the remaining 392 women who met study criteria and agreed to participate, 117 withdrew from participation, most often due to increased life demands. Thus, a total of N = 275 women were included in the present analyses – n = 138 comprise the sexually healthy cohort, which consisted of women with no indications of sexual dysfunction, and n = 137 comprise the low sexual desire cohort, which consisted of women who met operational criteria for HSDD.

Procedure

Upon obtaining written consent, an in-person meeting with a research assistant was scheduled to review the study procedures for the saliva sampling kit. Specifically, participants were instructed to allow saliva to pool in the mouth and deposit it into 1.6 ml vials through a straw at four time points in the diurnal cycle: at awakening, 30 and 60 min after waking, and immediately before bedtime, on 3 separate, typical weekdays (note: collection days were not required to be consecutive). For the purposes of the current study, only salivary cortisol measurements at 60 min after waking and immediately before bedtime were used as a measure of HPA axis functioning. The samples at the other time points (i.e., awakening and 30 min after waking) were collected for analyses concerning cortisol awakening response which are presented elsewhere (see Basson et al., 2019). Participants were asked to avoid consuming chocolate, alcohol, caffeine, and non-steroidal anti-inflammatories on saliva collection days, as these items may alter cortisol levels. Additionally, participants were asked to avoid eating, brushing teeth, flossing teeth, consuming beverages (other than water), using mouthwash, chewing gum, or eating a large meal within an hour of collecting a saliva sample, to avoid contamination. Prior to sample collection (except upon waking), participants were asked to perform a cold-water rinse. Samples were briefly stored in the participant's freezer (at approximately −15°C) until sample collection was completed at which point they were transported to the laboratory for analysis.

After the in-person meeting, each participant was emailed a link to an online questionnaire which could be completed at a time of her choosing. Following completion of the questionnaire and three-day saliva collection, each participant met with a research assistant for a second in-person meeting during which the Decreased Sexual Desire Screener (DSDS; Clayton et al., 2009) was administered. During this in-person meeting, we also administered the portion of the Structured Clinical Interview for DSM-IV Axis 1 disorders (non-patient version (SCID-I/NP) that assesses major depressive disorder to ensure participants did not meet diagnostic criteria for major depressive disorder. Data collection and study procedures were carried out in Canada and approved by the affiliated university and hospital research ethics board. All research participants provided written informed consent and were provided with a $100 honorarium for participation.

Measures

Demographics

Participants were asked several background questions (e.g., household income, employment status, number of children, number of pregnancies, height/weight, menopausal status, medical history, and sexual history, etc.). As women with HSDD are 2.5 times more likely to report relationship dissatisfaction (Leiblum, Koochaki, Rodenberg, Barton, & Rosen, 2006), information about relationship satisfaction was also collected from participants currently in a relationship.

Diagnostic Interview of HSDD

To assess participants for HSDD, the Decreased Sexual Desire Screener (DSDS) was administered in person. The DSDS is a 5-item clinician-administered diagnostic screener for generalized acquired HSDD in women (Clayton et al., 2009). Participants were presented with a set of four yes/no questions related to sexual desire. When all four items were endorsed, a fifth question was asked to rule out potentially confounding causes for decreased desire (i.e., medical illness, relationship factors, medications, obstetric or gynecological factors, or stress and/or fatigue). When respondents answered "yes" to questions 1–4 and "no" to all factors in question five, she received a diagnosis of HSDD. If a respondent answered "yes" to items 1–4 and "yes" to factors in item five, she also received a diagnosis of HSDD if, upon further assessment, those factors were not indicative of another primary diagnosis. The DSDS shows 85.2% diagnostic accuracy and high sensitivity and specificity, with point estimates of .84 and .88, respectively (Clayton et al., 2009).

Continuous Measure of Sexual Desire

To obtain a continuous measure of sexual desire (i.e., on a continuum/scale), we administered the Sexual Interest and Desire Inventory-Female (SIDI-F; Clayton et al., 2006). Given that some of the items of the scale exclude individuals not in a relationship, other items measure sexual arousal, and yet other items are potentially intercorrelated with depressive mood (i.e., frequency of positive thoughts about sexual activities), we selected the two items that capture the dimensions of sexual desire that are included in the diagnostic criteria for HSDD (American Psychiatric Association [APA], 2000): (1) *Desire* (Over the past month, how frequently and how strongly have you wanted to engage in some kind of sexual activity, either with or without a partner?; and (2) *Distress* (Over the past month, when you thought about sex or were approached for sex, how distressed (worried, concerned, guilty) were you about your level of desire? The possible total range for the two-item composite score was 0–9, with lower scores indicating a lower level of sexual desire, and higher levels mapping onto HSDD. Cronbach's alpha for the two items in the present sample was 0.77. Previous studies (Clayton et al., 2006) have shown that these two items are sensitive at distinguishing not only individuals with HSDD from women with no sexual dysfunction but also between women with HSDD and women with Female Orgasmic Disorder. Moreover, both items showed high correlations with the total SIDI score.

Beck Depression Inventory-II (BDI-II)

The BDI-II is a 21-question brief criteria-referenced instrument for measuring the severity of depression (Beck, Steer, & Brown, 1996). It is composed of items relating to symptoms of depression including hopelessness, sadness, pessimism, self-dislike, irritability, guilty feelings, feelings of being punished, fatigue, difficulty sleeping, loss of appetite, weight loss, and lack of interest in sex. Each item ranges from 0 to 3 and responses are summed to create a total score with a possible range of 0– 63. Greater severity of depressive symptomatology is represented by a higher score. The BDI-II is positively correlated with other measures of depression, such as the Hamilton Depression Rating Scale (r = 0.71) and shows strong 1-week test–retest reliability (r = 0.93). Cronbach's alpha for the BDI-II in the present sample was 0.89.

Childhood Trauma Questionnaire (CTQ)

The CTQ is a 27-item self-report retrospective assessment of the severity of various types of traumatic childhood experience (Bernstein & Fink, 1998). It consists of five clinical subscales, each comprised of five items: Emotional Abuse, Physical Abuse, Sexual Abuse, Emotional Neglect, and Physical Neglect. The questionnaire includes a two-item Minimization–Denial of Abuse scale which measures the potential of underreporting of childhood traumatic events. The examinee responds to 27 questions on a 5-point Likert scale ranging from 0 (*never*) to 5 (*very often*). Higher scores indicate higher incidences of child trauma. The CTQ showed strong internal consistency in the present sample, with a Cronbach's alpha of 0.92.

Perceived Stress Scale (PSS)

The PSS (Cohen & Williamson, 1988) is a 10 item scale used to measure the degree to which participants appraise their life as stressful. The questions measure how unpredictable, uncontrollable, and overloaded respondents find their lives. Participants are asked to rate the frequency of stressful events that occurred in the past month on a scale from 0 (*never*) to 4 (*very often*). Scores for individuals are obtained by reverse scoring four items and then summing the 10 items. The possible range of scores is 0–40, with higher scores indicating greater perceived stress. The PSS shows strong convergent validity with other stress measures and predictive validity with respect to health outcomes (e.g., frequent colds) and health behaviors (e.g., failure to quit smoking (Cohen & Williamson, 1988). The PSS showed high internal consistency in the present sample, with a Cronbach's alpha of 0.91.

Relationship Assessment Scale (RAS)

To control for relationship satisfaction, the RAS, a brief assessment of global relationship satisfaction (Hendrick, 1988), was administered to women who indicated they were currently in a relationship. The scale consists of seven items, each rated on a 5-point Likert scale ranging from 1 to 5. After reverse scoring two items, the seven items are summed to provide a total score of relationship satisfaction. Scores may range between 7 and 35, with higher scores indicating greater relationship satisfaction. The RAS is suitable for use with any individuals who are in an intimate relationship, such as married couples, cohabiting couples, engaged couples, or dating couples. The RAS shows moderate to high correlations with measures of marital satisfaction and good test–retest reliability (see Hendrick, Dicke, & Hendrick, 1998). The RAS showed high internal consistency in the present sample, with a Cronbach's alpha of 0.91.

Salivary Cortisol

To assay salivary cortisol concentrations, samples were vortexed and centrifuged for 10 min at 1,400 *g* and 18°C. Salivary cortisol was measured using the commercially available High Sensitivity Salivary Cortisol Enzyme Immunoassay Kit (Salimetrics Assays, 1–3002, State College, PA). This assay required a minimum of 25 µl of saliva, and intra- and inter-assay coefficients of variation were 4.6% and 6.0%, respectively.

As per Basson et al. (2019), the diurnal cortical slope was calculated by averaging the PM cortisol level across 3 days and averaging the AM (60-min post-waking measure) cortisol level across 3 days. The mean PM cortisol level was then subtracted from the mean AM cortisol level.

Data Analytic Plan

To ensure relative similarity in group composition, groups were compared on several demographic variables including age, ethnicity, highest education level, sexual orientation, relationship status, relationship duration, and menopausal status. No significant group difference on demographic variables was observed (all p's > .05; Table 1) with the exception of menopausal status; χ^2 (2) = 7.45, p = .024. As such, menopausal status was controlled for in our analysis. As basal cortisol levels do not appear to be influenced by the menstrual cycle phase (Kudielka & Kirschbaum, 2003; Wilson, Lorenz, & Heiman, 2018), these data was not collected.

Analyses were designed *a priori* and intended to test the hypothesis that childhood adversities, depression, and perceived stress, predict group membership (i.e., HSDD vs. control), over and above HPA axis dysregulation. We also intended to explore the degree to which diurnal cortisol slope, perceived stress, and depression symptoms, respectively, mediate the relationship between childhood trauma and sexual desire (measured continuously).

To assess the ability of HPA axis dysregulation, depressed mood, perceived stress, and childhood trauma history to predict group membership (i.e., HSDD vs. sexually healthy), a binary logistic regression was conducted. Variables of interest were added sequentially in three blocks: Block 1 (HPA axis variable of interest – diurnal cortisol slope); Block 2 (psychological variables of interest – depression symptoms, childhood trauma, and perceived stress); and Block 3 (control variables – relationship satisfaction and menopausal status). The nested logistic regression fits were compared on the basis of the likelihood ratio chi-square test. Wald tests were used to assess the significance of individual regression coefficients.

To examine the degree to which the relationship between childhood trauma and sexual desire is mediated by depressed mood, HPA axis (dys)regulation, and perceived stress, we performed a parallel mediation analysis using the PROCESS macro (Model 4) in SPSS version 23.0. PROCESS uses bootstrapping, a non-parametric resampling method that generates an estimate of the indirect effect by resampling, with replacement, the indirect

Table 1. Participant demographic characteristics for women with hypoactive sexual desire disorder (HSDD) and healthy controls.

	HSDD (n = 137)		Control (n = 138)	
Variable	*M*	*SD*	*M*	*SD*
Age	33.01	11.68	31.81	12.05
Relationship Duration (months)	83.50	88.86	75.79	98.95
	N	**%**	***N***	**%**
Race/Ethnicity				
Euro-Caucasian	83	60.6	81	58.7
East Asian	25	18.2	35	25.4
South Asian	9	6.6	9	6.5
First Nations	2	1.5	1	0.7
Middle Eastern	5	3.6	3	2.1
African-Canadian	2	1.5	1	0.7
Other	11	8.0	8	5.8
Education				
High School	13	9.5	25	18.1
College/Technical/Trade School	24	17.5	19	13.8
Undergraduate Degree	55	40.1	55	39.9
Master's Degree	29	21.2	23	16.7
Doctoral Degree	6	4.4	9	6.5
Other	10	7.3	7	5.1
Employment Status				
Full-Time	54	39.4	50	36.2
Part-Time	22	16.1	21	15.2
Self-Employed	6	4.4	8	5.8
Unemployed	2	1.5	1	.7
Retired	5	3.6	2	1.4
Student	39	28.5	52	37.7
Homemaker	3	2.2	1	0.7
Other	6	4.4	3	2.2
Sexual Orientation				
Heterosexual	115	83.9	114	82.6
Lesbian	4	2.9	4	2.9
Bisexual	12	8.8	15	10.9
Other	6	4.4	5	3.6
Relationship Status				
Single	27	19.7	40	29.0
Dating	29	21.2	44	31.9
Married/Cohabitating	72	52.6	45	32.6
Divorced	2	1.5	2	1.4
Widowed	2	1.5	1	0.7
Other	5	3.6	6	4.3
Menopausal Status				
Premenopausal	106	77.4	120	87.0
Perimenopausal	17	12.4	5	3.6
Postmenopausal	14	10.2	13	9.4

A significant group difference on menopausal status was observed (p = .024). No group difference on any other demographic variable was observed (p's > .05).

effect's sampling distribution (Hayes, 2013). Presently, the distribution was bootstrapped 10,000 times. The indirect effect is deemed statistically significant if the upper and lower 95% confidence intervals do not straddle zero. To facilitate interpretation, all coefficients reported were standardized.

Results

Preliminary Analyses

Prior to testing our hypotheses, a set of descriptive analyses were carried out to examine the variance within each measure and to determine the comparability of the present sample to other samples in the literature upon which our hypotheses were based. Results are presented in Table 2. Additionally, we calculated the intraclass correlation for AM and PM cortisol to partition the variance in these variables into individual (i.e., within) and group (i.e., between) components (Raudenbush & Bryk, 2002). The results indicated a significant degree of variance in AM and PM cortisol was attributable to within-person difference (58% for AM and 74% for PM). This degree of intraindividual difference was not unexpected and is consistent with research showing moderate variability in day-to-day cortisol levels (e.g., Adam, Hawkley, Kudielka, & Cacioppo, 2006). Thus, the results confirm that our approach of creating a mean score across the 3 days was indeed appropriate.

Prediction of HSDD vs. Control Group Membership Based on Cortisol Slope, Depression, Perceived Stress, and Childhood Trauma

A logistic regression based only on diurnal cortisol slope provided significant predictive capability, such that correct group assignment was predicted in 54.1% of cases. In this model, for every one unit increase in diurnal cortisol slope, the odds of meeting HSDD criteria decreased by 34%, indicating that participants in the HSDD group were more likely to have cortisol slopes indicative of dysregulation. When measures of childhood trauma, depression, and perceived stress were added to the model, the model's fit significantly improved (χ^2 = 25.11, p < .001). The amount of unexplained variance (−2LL) decreased from 251.07 to 225.98. When childhood trauma, depression, and perceived stress were added to the model, the diurnal cortisol slope remained a significant predictor of group assignment (p = .04). While depression symptoms significantly improved prediction of group assignment in this second model (p < .001), childhood trauma (p = .41) and perceived stress (p = .95) did not. With all four variables (i.e., diurnal cortisol slope, depression, childhood trauma, and perceived stress) in the model, the correct group assignment was predicted in 68.1% of cases. In this model, for every one unit increase in diurnal cortisol slope, the odds of meeting HSDD criteria decreased by 35%, whereas for every one unit increase in depression score, the odds of meeting HSDD criteria increased by 178%. Thus, participants in the HSDD group were more likely to have a flatter diurnal cortisol slope and greater depressive symptomatology compared to those in the control group.

To control for relationship satisfaction and menopausal status, these variables were added to the model in a third block. Doing so significantly improved the model fit (χ^2 = 12.07, p = .002), and the amount of unexplained variance (−2LL) decreased from 225.98 to 213.92. Diurnal cortisol slope and depression remained significant predictors of group assignment in this third model, and relationship satisfaction was also found to be a significant predictor of group assignment (p = .002). With all six variables in the model (i.e., diurnal cortisol slope, depression, childhood trauma, perceived stress, relationship satisfaction, and menopausal status), the correct group assignment was predicted in 70.3% of cases. In this model, for every one unit increase in cortisol slope and relationship satisfaction score, the odds of meeting criteria for HSDD decreased by 43% and 47%, respectively, whereas for every one unit increase in depression score, the odds of meeting HSDD criteria increased by 169%. Thus, participants in the HSDD group were more likely to have a flatter diurnal cortisol slope, lower relationship satisfaction, and greater depressive symptomatology compared

Table 2. Mean (plus standard deviation) scores for cortisol slope, childhood trauma, depressive symptoms, and perceived stress in women with hypoactive sexual desire disorder (HSDD) and healthy controls.

	HSDD (*n*= 137)			Control (*n*= 138)				
Variable	*M*	*SD*	Range	*M*	*SD*	Range	*t*(*df*)	*p*
Cortisol Slope	6.44	4.41	−.04 – 21.16	7.87	3.92	−11.59 – 25.46	2.85(273)	.005
Childhood Trauma[a]	39.59	13.25	25 – 70	35.08	10.86	25 – 86	−3.07(271)	.002
Depression[b]	10.56	7.54	0 – 30	5.66	6.38	0 – 42	−5.77(268)	<.001
Perceived Stress[c]	16.26	7.19	0 – 33	12.70	6.74	0 – 33	−4.22(272)	<.001

Scale ranges: [a]5–125; [b]0–63; [c]0–40.

to those in the control group. Binary logistic regression results for the complete model are presented in Table 3.

Parallel Mediation Analysis of Mood and Perceived Stress on the Relationship between Childhood Trauma and Sexual Functioning

A parallel mediation analysis indicated that childhood trauma was indirectly related to sexual desire through its relationship with depression. No indirect relationship between childhood trauma and sexual desire through diurnal cortisol slope or perceived stress was observed. As can be seen in Figure 1, greater endorsement of childhood trauma predicted more depressive symptoms (b = 0.35, p < .001), and higher levels of perceived stress (b = 0.26, p < .001). There was no significant relationship indicated between childhood trauma and diurnal cortisol slope (b = −0.06, p = .32). Further, lower mood predicted lower sexual desire (b = −0.44, p < .001), as did a flatter diurnal cortisol slope (b = −0.14, p = .02), whereas perceived stress did not significantly predict sexual desire (b = −0.01, p = .85). When accounting for depression, perceived stress, and diurnal cortisol slope, the relationship between childhood trauma and sexual desire (b = −0.14, p = .03) failed to reach statistical significance (b = 0.03, p = .66), indicating

Table 3. Binary logistic regression analysis of diurnal cortisol slope, childhood trauma, depressive symptoms, perceived stress, relationship satisfaction and menopausal status predicting group membership (i.e., HSDD vs. control).

Source	*B*	*SE B*	Wald χ^2	*p*	Exp(*B*)	95% CI
Cortisol Slope	−0.57	−0.23	6.42	0.01	0.57	[0.36, 0.88]
Childhood Trauma	−0.17	0.21	0.68	0.41	0.84	[0.56, 1.27]
Depression	0.99	0.28	12.40	<.001	2.69	[1.55, 4.68]
Perceived Stress	−0.33	0.24	1.86	0.17	0.72	[0.45, 1.15]
Relationship Satisfaction	−0.64	0.20	9.85	.002	0.53	[0.35, 0.79]
Menopausal Status	0.10	0.28	0.12	.727	1.10	[0.63, 1.92]

Odds ratios predict assignment to the HSDD group.

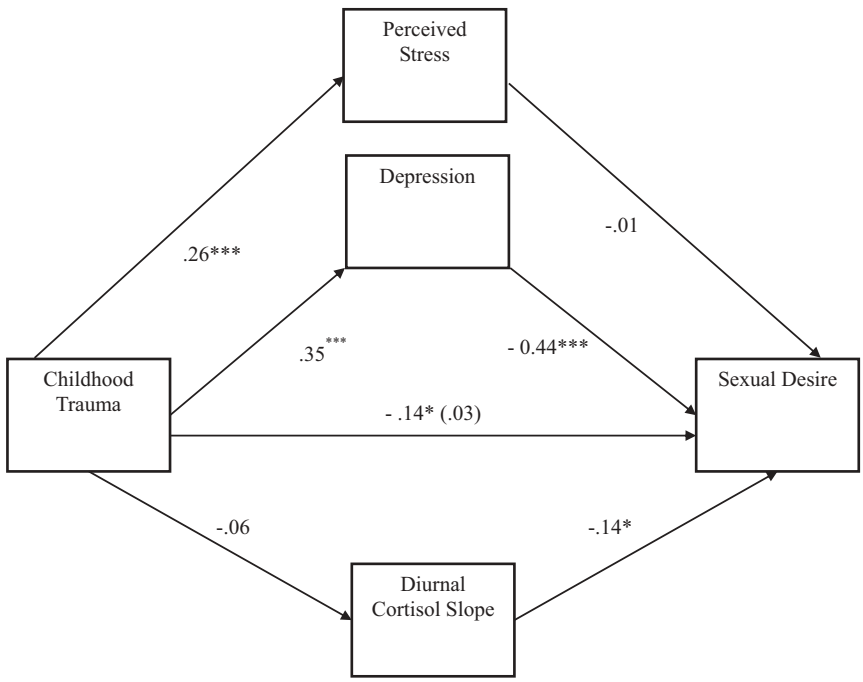

Figure 1. Standardized regression coefficients for the relationships between early life adversities and sexual desire mediated by depression, perceived stress, and cortisol slope. The standardized regression coefficient between early life adversities and sexual desire, controlling for depression and perceived stress is in parentheses.

*p <.05, ***p < .001.

that the variance in sexual desire previously attributed to childhood trauma could be explained by these other three variables.

A 95% bias-corrected confidence interval based on 10,000 bootstrap samples indicated that the indirect effect through depression, accounting for perceived stress and diurnal cortisol slope, was entirely below zero (−0.25 to −0.09), demonstrating a significant mediation effect. In contrast, the indirect effects through perceived stress (−0.05 to 0.04) and diurnal cortisol slope (−0.04 to 0.01) straddled zero, indicating no mediation effect. The full parallel mediation model is presented in Figure 1.

Due to the unexpected lack of association between childhood trauma and diurnal cortisol slope, post hoc analyses were carried out to examine the distribution of childhood trauma scores in relation to diurnal cortisol slope scores. First, we divided the sample into those who reported no childhood trauma (i.e., a score of 25 on the CTQ), those who reported moderate childhood trauma (determined by a CTQ score of 26–50 on the CTQ), and those who reported severe childhood trauma (determined by a CTQ score of >50). For the sub-group reporting no childhood trauma, the mean for diurnal cortisol slope was 7.16 (−.26 to 13.54). For the sub-group reporting moderate childhood trauma, the mean for diurnal cortisol slope was 7.29 (−6.44 to 25.30). For the sub-group reporting severe childhood trauma, the mean diurnal cortisol slope was 6.26 (−11.59 to 25.46). Interestingly, the range for the subgroup reporting severe childhood trauma was greatest and reflects the lowest and highest scores for diurnal cortisol slope within the entire sample. Further, we examined whether the relationship between childhood trauma and diurnal cortisol slope was moderated by group assignment (i.e., HSDD vs. sexually healthy). The result was non-significant (b =0.14, t (252) = 1.12, p = .263).

Discussion

Despite low sexual desire being the most commonly reported sexual problem among women (McCabe et al., 2016) and childhood adversities being quite common and highly correlated with low sexual desire (Neumann et al., 1996), clinicians are left without guidance in terms of important targets for treatment. Indeed, currently developed treatments for sexual dysfunctions that target trauma survivors are unfortunately absent in the literature. To help fill this gap, the present study focused on the individual effect of childhood adversities, daily stress, depressive symptoms, and HPA axis (dys)regulation on sexual desire in women. We also examined the mediating effect of depression, perceived stress and HPA axis function (as indexed by diurnal cortisol slope), respectively, on the relationship between childhood trauma and low sexual desire.

Depression in the Context of Sexual Desire

Although the results of this study do not suggest that psychological variables have a greater overall association with sexual desire compared to physiological variables, we found that depression was the single most potent predictor of HSDD diagnosis, even when HPA axis function, perceived stress, and childhood trauma were accounted for. The significant association of depression with women's low sexual desire was further evidenced by the mediation analysis, which showed that childhood adversities relate to sexual desire largely through depressive symptoms, and not significantly through diurnal cortisol slope or perceived stress. Thus, the results of this study indicate depression is a key independent and mediating factor in the prediction of low sexual desire. The significance of these findings is even greater when it is considered that women with a diagnosis of clinical depression were excluded from this study (though the range of scores suggests several participants may have had subthreshold depressive symptoms). This indicates that low mood generally, and depressive symptoms specifically, strongly predict women's low sexual desire. One explanation for this finding is that common depressive symptoms lead to an inhibition of sexual desire, for example, the tendency to withdraw, low self-esteem, or poor body image (Hartmann, Heiser, Rüffer-Hesse, & Kloth, 2002). This finding may further be explained by research showing that depression may potentiate sexual self-schemas of being a-romantic/non-passionate for women with a history of childhood adversity (childhood sexual abuse, specifically; Meston, Rellini, & Heiman, 2006). Another explanation may be that the impact of depression on sexual function, for example, impairment in vaginal lubrication, difficulty reaching arousal and orgasm, and greater sexual pain (Frohlich & Meston, 2002), results in fewer pleasant sexual encounters, lower sexual satisfaction, and ultimately, little motivation for engagement in future sexual activity.

HPA Axis and Sexual Desire

As expected, we found that diurnal cortisol slope, alone, was significantly associated with HSDD. This is consistent with previous literature which implicates cortisol in sexual motivation and response (e.g., Hamilton et al., 2008), and provides further support to the conclusion that HPA axis dysregulation is a common contributing factor to low sexual desire. Although we expected childhood trauma, perceived daily stress, and depression symptoms would be stronger predictors of sexual desire than diurnal cortisol slope alone, we found that diurnal cortisol slope continued to be a significant predictor of HSDD diagnosis, despite the addition of the psychological variables to the model. Based on these results, it cannot be said that the psychological variables in question (i.e., depression, childhood trauma, and perceived stress) predict HSDD over and above the HPA axis function. It may be the case that a flatter diurnal cortisol slope in women with HSDD reflects a past stressful life – a predisposing factor itself to low sexual desire – with the resulting hormonal dysregulation becoming an independent risk factor for HSDD. This finding highlights the complex and multimodal nature of low sexual desire in women and emphasizes the importance of conceptualizing and treating sexual desire concerns from a biopsychosocial framework.

Perceived Stress and Sexual Desire

Findings from this study support the relationship between childhood adversities and both depressive symptoms and daily stress; however, the unique contribution of daily stress

on sexual desire did not reach significance, indicating that proximal stressors may not contribute as significantly to sexual desire problems among women with a history of childhood adversities as previously indicated. This is in contrast to previous studies that found that daily stress had an important mediating effect for general sexual functioning in survivors of childhood sexual abuse, even when controlling for posttraumatic stress disorder symptoms (e.g., Zollman et al., 2013). The contrast in results between the present and previous studies may be a function of the timeframe for which reactions to distressing events were measured. For example, in Zollman et al. (2013), an assessment was conducted for reactions to daily stressors that occurred in the last 24 hr, whereas in the present study, participants' perceived stressors over a 1-month period was assessed. Presumably, a stressor experienced in the past 24 hr results in a more acute reaction, and thus, a more significant impact on sexual desire was observed as compared to general stress over a 1-month period. Alternatively, it is possible that excluding women with a diagnosis of clinical depression resulted in the exclusion of women with low desire with higher levels of daily stress, resulting in a null finding.

HPA Axis (Dys)regulation and Childhood Trauma

Unexpectedly, our mediation analyses showed an apparent lack of relationship between childhood trauma and diurnal cortisol slope. Given the inconsistency of this finding with the extant literature, we conducted a post-hoc analysis to better understand the meaning of this unanticipated result. Additional analyses revealed that the largest range of diurnal cortisol slope scores occurred in the sub-sample of individuals reporting severe childhood trauma, with a narrower range in the moderate and no childhood trauma groups. In fact, the highest and lowest diurnal cortisol slope scores observed in the entire sample occurred in the severe childhood trauma sub-group. Thus, despite the regression analysis indicating no relationship between childhood trauma and diurnal cortisol slope, it appears it would be more accurate to conclude that childhood trauma is associated with dysregulation in the diurnal cortisol slope, albeit with variable direction of dysregulation. This conclusion may help to explain why several previous studies have inconsistent findings concerning cortisol and early life adversity – why some studies point to hypercortisolism (e.g., Cicchetti & Rogosch, 2001), and others hypocortisolism (e.g., Heim et al., 2001) in relation to childhood trauma. To better understand this phenomenon, future research would benefit from an examination of the mediating and moderating variables which may impact the direction of cortisol dysregulation in individuals reporting severe childhood trauma.

Limitations

While this study contributes to an understanding of the different factors that affect the sexual desire of survivors of childhood traumas, it is important to keep in mind the limitations of its cross-sectional design. The study of childhood adversities on adult functioning, and especially sexual functioning, is in most cases limited by problems with retrospective self-reports. Prospective studies that follow participants with reported experiences of abuse or neglect from childhood to adulthood can answer questions about causality more definitively than the current practice of cross-sectional analyses. However, such a design does carry its own set of problems as these studies often do not include appropriate measures of sexual function; are prohibitively expensive, and the majority of individuals who suffered childhood adversities do not disclose this information to the authorities (Fergusson, Horwood, & Woodward, 2000).

Another limitation in this study is the use of cross-sectional data to test mediation that assumes a temporal effect. Given this limitation, we are unable to deduce whether the depressive symptoms preceded or followed low sexual desire, and likewise, whether childhood trauma preceded depression symptoms. These are important questions to address in future studies. Further, and highly relevant for clinical practice, is the question of whether elimination of depressive symptoms is followed by an increase in sexual desire.

Additionally, 117 women withdrew participation due to an increase in life demands. As these women may have had more daily stress relative to women who remained in the study, it is possible that this heightened level of stress was not accounted for in analyses. Furthermore, the use of medications known to disrupt sexual functioning (e.g., antidepressants) was a major exclusion criterion. This may limit the generalizability of findings to the broader sample of women with a history of childhood trauma. Generalizability may further be limited by the fact that women with a current diagnosis of depression were excluded from the study and thus, our cohort of women may not have been fully representative of the majority of women with low desire.

Finally, this study began when HSDD was still the accepted diagnosis of low sexual desire according to the DSM-IV-TR; however, midway through the study, the DSM-5 was released, and female HSDD was replaced by Sexual Interest/Arousal Disorder (SIAD). Given the criteria for diagnosing HSDD are narrower than for SIAD (O'Loughlin, Basson, & Brotto, 2018) some of the current HSDD participants may not fit a SIAD diagnosis, and thus a reclassification may have placed them into the control group. Future research should aim to replicate these findings in women meeting criteria for SIAD (APA, 2013).

Clinical Implications

This study adds to the extant knowledge on childhood adversities and sexual desire by pointing to depressive symptoms as key factors implicated in HSDD. It is noteworthy that this relationship was observed even in a sample of women that did not meet clinical criteria for major depression and therefore highlights the importance that depressive symptoms may have on sexual function. This information is relevant both for the therapist treating depressive symptoms in survivors of early trauma and for therapists treating sexual desire concerns in this

population. The field of psychotherapy is moving toward an integration of different therapies to address multiple symptoms independently from the unique diagnoses because our clients present with a complex picture of overlapping pathologies (Barlow, Allen, & Choate, 2004). In line with this approach, findings from this study point to the utility of conducting assessment for depression in women presenting with low desire and integrating treatments that simultaneously address sexual desire and depression. Moreover, results from this study suggest that when women present with comorbid trauma history, depression, and low sexual desire, depression may be an effective intervention point for treatment. Finally, this study indicates that severe childhood trauma impacts sexual desire through a dysregulated diurnal cortisol slope – both low and high slopes – an important marker of HPA axis functioning.

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Declaration of interest

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