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Psychological and Autonomic Correlates of Emotion Dysregulation Among Women in Substance Use Disorder Treatment

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1. Introduction

Increasingly, emotion dysregulation is being recognized as a potential key target for substance use prevention and treatment interventions based on research showing links between emotion dysregulation and substance use (Kelly & Bardo, 2016). Emotion dysregulation is characterized by intense emotions, low distress tolerance, experiential avoidance, and lack of control/strategies to manage emotions (Eftekhari, Zoellner, & Vigil, 2009; Moore, Zoellner, & Mollenholt, 2008). Deficits in emotion regulation are common clinically, particularly among individuals with a substance use disorder (SUD) with internalizing, externalizing, or co-occurring internalizing/externalizing forms of psychopathology (Gross & Munoz, 1995; Vasilev, Crowell, Beauchaine, Mead, & Gatzke-Kopp, 2009). Specifically, substance use research findings show that self-reported emotion regulation difficulties: (1) differentiate those in substance use disorder treatment from community controls (Fox, Axelrod, Paliwal, Sleeper, & Sinha, 2007; Fox, Hong, & Sinha, 2008), (2) are linked to coping motives for use (Bonn-Miller, Vujanovic, & Zvolensky, 2008; Stasiewicz et al., 2013), (3) are highly associated with childhood interpersonal trauma and with post-traumatic stress disorder (PTSD) (Dube et al., 2006; Strine et al., 2012; Weiss, Tull, Anestis, & Gratz, 2013; Weiss, Tull, Lavender, & Gratz, 2013; Weiss, Kung, & Pearson, 2003), and (4) predict post-treatment relapse (Berking et al., 2012).

The prevalence of co-morbid mental health conditions (~ 45%) among individuals in SUD treatment is high (Substance Abuse and Mental Health Services, 2016). This, along with the high prevalence of interpersonal trauma among women in treatment compared to men (Greenfield et al., 2007), has increased interest and research on emotion regulation,

particularly the relation between emotion regulation and psychological symptoms (e.g., trauma and depression) among individuals in SUD treatment in order to improve SUD treatment outcomes (Banducci, Hoffman, Lejuez, & Koenen, 2014; Hopwood, Schade, Matusiewicz, Daughters, & Lejuez, 2015; Hoseiny, Jadidi, Habiballah Nataj, & Saberi-Zafarghandi, 2015; McDermott, Tull, Gratz, Daughters, & Lejuez, 2009; Tull, Weiss, Adams, & Gratz, 2012; Watkins, Schumacher, & Coffey, 2016; Weiss, Tull, Lavender, et al., 2013).

In addition, neurobiological research indicates an association between emotion regulation and interoception (Craig, 2015). Interoception involves is the ability to identify and access internal sensory cues (Cameron, 2001; McGlone & Reilly, 2010). Neuroimaging research, see review (Paulus & Stewart, 2014) indicates that people with SUD have significantly more interoceptive dysfunction compared to healthy controls. The findings from this research suggest the importance of interoceptive awareness training to improve emotion regulation among people with SUD (Noel, Brevers, & Bechara, 2013; Paulus & Stewart, 2014; Paulus, Stewart, & Haase, 2013). The link between emotion dysregulation and key health outcomes is of particular relevance for SUD due to the demonstrated post-treatment relapse risk factors of stress, negative affect and poor emotion regulation (Sinha et al., 2009; Sinha & Li, 2007). Importantly, treatment studies show associations between improved emotion regulation and reduced substance use and mental health outcomes such as anxiety and depression (Axelrod, Pereplechikova, Holtzman, & Sinha, 2011; Berking et al., 2012; Price, Wells, Donovan, & Rue, 2012), suggesting a critical role of emotion regulation in positive treatment outcomes. Likewise, interoception and emotion regulation are identified as a possible mechanisms underlying mindfulness-based interventions in SUD treatment studies (Garland, Roberts-Lewis, Kelley, Tronnier, & Hanley, 2014; Witkiewitz, Lustyk, & Bowen, 2013).

The majority of SUD research examining emotion dysregulation uses self-report measures, most commonly the Difficulties in Emotion Regulation Scale (DERS) (Gratz & Roemer, 2004). However, researchers have increasingly begun to examine psychophysiological measures with links to emotion dysregulation, such as respiratory sinus arrhythmia (RSA). RSA is a peripheral measure of parasympathetic-mediated cardiac output, measured via beat-to-beat fluctuations in heart rate across the respiratory cycle (Beauchaine, 2001; Porges, 2007). Under appropriate stimulus conditions, RSA can serve as a valid and reliable psychophysiological index of emotion dysregulation (Beauchaine, 2001; Beauchaine & Thayer, 2015). Psychophysiolgists theorize that higher resting state RSA (i.e., greater heart rate variability across the respiratory cycle) marks better conservation of bodily resources, the ability to adapt flexibly to stressors, and higher self-regulatory capacity (Porges, 2007). Importantly, DERS scales often correspond with resting-state RSA (also referred to as heart rate variability) (Williams et al., 2015) and with RSA reactivity to emotionally evocative stimuli (Tull, Gratz, Latzman, Kimbrel, & Lejuez, 2010; Vasilev et al., 2009). However, there is an identified lack of psychophysiological explorations of emotion dysregulation in SUD treatment studies (Kelly & Bardo, 2016; Price & Crowell, 2016; Weiss, Tull, Lavender, et al., 2013). Using psychophysiological measures in clinical research is consistent with multiple-levels-of-analysis approaches recommended by the NIH (Insel et al., 2010). However, few researchers have used multiple measures to examine emotion dysregulation in treatment-seeking patients with SUDs. Thus, associations between RSA, self-reported health

outcomes ~including interoceptive awareness and mindfulness skills, and substance use, is unknown.

The purpose of this exploratory study was to generate new knowledge regarding RSA as a physiologic marker of emotion dysregulation and health outcomes, important for identifying biomarkers that may elucidate underlying mechanisms in interventions used in SUD treatment research. There were three aims of this study. The first aim was to describe the background and characteristics of women in early treatment for chemical dependency, including their lifetime trauma exposure, substance use, psychological symptoms (trauma, emotion regulation difficulties, and depression), interoceptive awareness, mindfulness skills, and resting-state RSA. The second aim was to examine the correlations between self-reported substance use and health outcomes (psychological distress, interoceptive awareness, and mindfulness skills). The third aim was to test the association between RSA, self-reported health outcomes, and recent substance use (using biochemical data). We hypothesized that RSA would be significantly and negatively associated with psychological symptoms, and significantly and positively associated with interoceptive awareness and mindfulness skills. We did not expect substance use to be associated with RSA. To our knowledge, this is the first women's SUD treatment study to collect RSA and examine these relationships.

2. Method

2.1 Study design and enrollment

A NIDA-funded study RCT to examine interoceptive awareness training in women's SUD treatment provided the opportunity to examine the relationship between self-reported health outcomes and psychophysiological profiles of women in recovery from chemical dependency. This study received Human Subjects Institutional Review Board approval from the University of Washington. Data for this paper was collected at baseline, prior to randomization to study treatment groups.

Study participants were recruited from three community clinics in the NW United States that served a large proportion of women (i.e. 50% of enrolled patients). Recruitment strategies included self-referral through flyers posted at the clinics and distributed at IOP sessions by the Research Coordinator. The flyer explained that study participation involved randomization to one of three study conditions, and that two conditions involve receiving an 8-week intervention with a focus on the body. The Research Coordinator at each clinical site screened interested participants for study eligibility. Inclusion criteria were: (1) female, (2) enrolled in IOP, (3) agreed to forgo (non-study) manual therapies (e.g., massage) and mind-body therapies (e.g., mindfulness meditation) for 3 months (baseline to post-test); (4) willing to sign release for access of electronic medical records; (5) fluent in English; and (6) can attend intervention sessions when offered. Exclusion criteria were: (1) untreated psychotic diagnosis or symptoms, (2) unwilling or unable to remain in treatment for the duration of the trial (e.g., planned relocation, pending incarceration, upcoming surgical procedures); (3) cognitive impairment based on an informed consent assessment of demonstrated difficulty in comprehension of the consent; or (4) currently pregnant.

2.2 Data Collection and Procedures

Patients eligible for study participation who provided consent for study participation, were administered the baseline assessment at the clinic where they received SUD treatment. Data collection procedures, administered by trained research coordinators, involved an interview calendar method to collect information on self-reported substance use over the past 90 days; a biochemical assay to test for recent use of alcohol or drugs; an online survey to collect demographics, health history and economic characteristics, and health outcomes; and a procedure to collect RSA. To reduce variability associated with non-psychological influences on psychophysiology, assessment procedures were designed so that participants did not eat, drink, or smoke cigarettes for a standardized period of time (1 hour minimum) prior to collecting RSA (Hawkley, Burleson, Berntson, & Cacioppo, 2003). Other variables that could influence physiological responding such as age, race, primary substance, tobacco use, height and weight to calculate body mass index (BMI) were collected as possible covariates in the analysis (Hawkley et al., 2003). The baseline assessment took approximately two hours to complete for which participants were remunerated \$30.

To collect RSA, electrodes were placed on participants' torso using a standard spot configuration with one electrode placed on the right shoulder and the other on the left abdomen near the bottom of the ribcage (Qu, Zhang, Webster, & Tompkins, 1986). Tonic (i.e., resting-state) RSA was measured during a five-minute baseline period, during which participants were asked to rest quietly and refrain from moving. Data were recorded using a Biopac MP150 system and sampled at 1kHz (Biopac Systems Inc., Goleta, CA, USA) with Mindware HRV software used for scoring.

2.3 Measures

2.3.1 Participant demographics, health history, and trauma exposure.—A demographic and health history form was used to gather information regarding socioeconomic status, racial/ethnic identity, and health history including past SUD treatment and current medications. An Economic Indicators Form was used to gather details regarding participant employment, healthcare utilization and legal status. The Traumatic Life Events Questionnaire (TLEQ) (Kubany et al., 2000) was used to describe lifetime trauma exposure.

2.3.2 Psychological symptoms

Trauma symptoms.: The PTSD Symptom Scale-Self Report (PSS-SR) (Foa, Riggs, Dancu, & Rothbaum, 1993), a 17-item questionnaire was used to assess Post-Traumatic Stress Disorder (PTSD) symptom frequency based on DSM-IV-TR criteria (American Psychiatric Association, 2000). Total scores range from 0–51; a score above 14 was the screening cut-off for PTSD (Coffey, Dansky, Falsetti, Saladin, & Brady, 1998). Internal consistency reliability (Cronbach's alpha) was 0.93.

Emotion regulation difficulties.: The self-report Difficulties with Emotion Regulation Scale (DERS) (Gratz & Roemer, 2004) consists of 36 items. Total scores can range from 36 to 180, with higher scores corresponding to greater dysregulation. Cronbach's alpha was 0.96.

Depression.: The Beck Depression Inventory-II (BDI-II), a 21-item questionnaire was used to measure severity of depressive symptoms (Beck, Steer, & Brown, 1996). Scores range from 0 – 63; scores above 29 depict a severe range for depression. BDI Cronbach's alpha was 0.92.

2.3.3 Interoceptive Awareness and Mindfulness

Interoceptive Awareness.: The Multidimensional Assessment of Interoceptive Awareness (MAIA) (Mehling, Price, Daubenmier, Acree, & Stewart, 2012) was used to assess interoceptive awareness skills. The MAIA has 32 items; total scores can range from 0– 5. MAIA Cronbach's alpha was 0.95.

Mindfulness Skills.: The Frieberg Mindfulness Scale (FMQ) that measures the practice of mindfulness skills using a 4-point Likert scale (Walach, Buchheld, Buttenmüller, Kleinknecht, & Schmidt, 2006). Validated in a number of prior studies (Feicht et al., 2013; Sauer, Walach, Offenbacher, Lynch, & Kohls, 2011), the Cronbach's alpha for the FMI was 0.91 in this sample.

2.3.4 Substance use.—To gather self-report data on substance use, we asked participants to report on their substance use over the past 90 days using the Time-line Follow-back interview (TLFB) (Sobell et al., 1996). The TLFB calendar method was used to identify primary substance; the score is the mean days abstinent from substance use for the prior 90 day period.

A biochemical urine toxicology screen was used to gather data on recent substance use. The toxicology screen tested for opioids, cocaine, amphetamines, methamphetamines, marijuana, and alcohol.

2.3.5 Physiological measure of emotion dysregulation

Respiratory Sinus Arrhythmia.: RSA is a peripheral index of parasympathetic nervous system (PNS) mediated cardiac control, measured as the natural fluctuations in heart rate across the respiratory cycle (T. Beauchaine, 2001; Porges, 2007). Lower baseline RSA has been associated with poor emotion regulation abilities in several clinical populations and is thought to be a marker of vulnerability to emotion dysregulation (Beauchaine, 2015; Beauchaine, Gatzke-Kopp, & Mead, 2007; Crowell et al., 2005; Thayer, Hansen, Saus-Rose, & Johnsen, 2009).

For *tonic RSA*, the resting period was scored in ten 30-second epochs (allowing for maximum flexibility in analyses), then averaged across baseline epochs to produce a mean resting-state RSA value for each participant. Using the MindWare HRV 3.0.10 software suite, RSA was derived by calculating spectral-power in ms^2/Hz using fast Fourier transformations in the high frequency range ($.15 \text{ Hz}$) of the beat-to-beat time series (i.e. interbeat interval) extracted from the ECG signal (Rottenberg, Ray, & Gross, 2007). The mean heartrate for the sample was 74.48 beats/minute, with a range from 47.62 – 111.79. MindWare HRV 3.0.10 automatically computes a log transformation, resulting in a final RSA value of $\log(\text{beats}/\text{min}^2/\text{Hertz})$. Cases with outlier RSA data or extreme values (i.e., <

2 or > 10) were reviewed by a senior investigator to determine if these were due to biological abnormality that could account for outlier status (e.g. cardiac arrhythmias). In this sample, cardiac arrhythmias were rare and were addressed using the midbeat interpolation option in Mindware Software. Thus, no participants were removed from the dataset due to arrhythmias. Three participants had extreme scores (two < 2 and 1 >10) that were determined to be viable after all levels of cleaning and were included in the analysis after determining that their scores didn't affect the analytic results. Movement artifacts resulted in unusable baseline RSA data for five participants.

2.4 Data analysis

We used descriptive statistics (frequencies, mean, sd, range) to summarize sample demographic and social factors, health indicators and self-report survey scales. We explored for associations among the specified self-reported substance use and health outcomes of psychological symptoms (trauma symptoms, emotion regulation, depression), interoceptive awareness and mindfulness skills, using Pearson product-moment correlations. Hierarchical (blocked) regression was used to assess for the influence of potential covariates (age, race, tobacco use, and BMI). BMI and age were identified as significant covariates and statistically adjusted in all subsequent analyses. Multivariate linear regression was used to address the overarching hypotheses and examine the relationships between resting RSA and trauma symptoms, emotion regulation, depression symptoms, interoceptive awareness, mindfulness skills, and substance use, adjusting for age and BMI. All analyses were conducted using Stata 15.1.

3. Results

3.1 Sample characteristics

3.1.1 Demographics and economic status.—The women ($N=217$) who enrolled in the study ranged in age from 20–61 years old. The majority (75%) identified their race as Caucasian, and 10% identified their ethnicity as Hispanic (Table 1); these racial/ethnic proportions are representative of the region. Most participants had graduated from high school however only 7% had a college degree. The majority were mothers of children under 18 years of age. Also, most were single, with only 15% in a committed relationship. Generally, the sample was low in socio-economic status: few participants were currently employed and most (87%) were receiving Medicaid and/or Medicare for health insurance. Only 55% reported having permanent housing.

3.1.2 Court involvement.—The majority 53% of the study participants had court involvement leading to their substance use treatment. Of these, 32% were charged with driving under the influence (DUI); the remaining 38% had an open case with Child Protective Services (CPS), involving 31% of the mothers with children under the age of 18.

3.1.3 Lifetime trauma history and mental health care.—The trauma histories of the women in this study were extensive, involving both interpersonal and other types of trauma. All study participants reported at least one interpersonal traumatic event, with domestic violence being the most prevalent, followed by childhood physical and/or sexual

abuse (Table 2). Other highly prevalent traumatic events included witnessing family violence (68%), witnessing someone being beaten up (45%), and being badly hurt by a stranger (40%). In addition, traumatic events involving less interpersonal violence were also highly prevalent such as motor vehicle accidents (45%) and having a loved one survive a life threatening accident, assault or illness (58%).

Despite the high lifetime exposure to trauma among the women in this sample, 50% had received few (0–9 sessions) mental health services (e.g., psychotherapy, counseling) in their lifetime. Another 20% had received moderate lifetime mental health services (10–30 sessions), and 30% had received more services (over 30 sessions in lifetime). In the past 90 days, 48% had received some mental health services (not specific to SUD treatment) and 50% were taking psychotropic medications for psychological support, including sleep.

3.1.4 Substance use.—Treatment for a substance use disorder was a recurrent experience for the majority of this sample, 71% of whom had sought treatment previously. The primary substances for which they sought treatment varied from stimulants (45%), alcohol (39%), narcotics (24%); marijuana (8%), other opiates or analgesics (6%); 22% indicated using more than one primary drug. Because many study participants had been in a controlled environment prior to the current outpatient treatment (detox; 26%, and/or jail, 22%), 37% reported no drug or alcohol use in the past 90 days (see Table 3). The biochemical toxicology screen result indicated that 17% were positive for substance use at the time of the study assessment.

3.2 Self-report profile and correlations between self-report health outcomes

Participant mean scores (Table 3) indicated high symptom distress: 68% scored above the screening cut-off for PTSD and 34% of the sample scored in the moderate to severe range for depression symptoms. The mean for self-reported emotion dysregulation on the DERS was 85.4, a value similar to other cross-sectional studies with this population (Weiss, Tull, Lavender, et al., 2013). The overall means for the total interoceptive awareness and mindfulness measures were fell close to mid-range, indicating overall low to moderate interoceptive and mindfulness skills.

Days abstinent from substance use was not significantly associated with self-reported health outcomes (range of bivariate correlations = $-.11$ – $-.04$). The correlations across the self-report health outcome measures (see Table 4) were generally significant and of moderate magnitude between $.32$ – $.66$. The exception was the MAIA which showed a small and non-significant correlation with the PSS-SR indicating that symptoms of trauma were not significantly associated with interoceptive awareness.

3.3 Psychophysiological profile and association with health outcomes

Resting RSA values were normally distributed (skew = $-.41$; kurtosis = 3.8) around a mean of 5.60 ($SD = 1.47$; range = $.27$ – 10.1). Age and BMI were significant predictors of associations between RSA and health outcomes, with t values ranging from -8.32 to 7.85 ($p < .001$) and -2.29 to -2.06 ($p < .05$), respectively. Age and BMI were significant predictors of associations between RSA and health outcomes, with t values of -8.22 ($p < .001$) and

–1.96 ($p = .051$), respectively. The findings indicated that, after adjusting for age and BMI, only the MAIA ($b = .28$, $t = 2.19$, $p = .03$) was significantly associated with RSA (see Table 5). Thus, individuals with more interoceptive awareness skills, as measured by the MAIA, had higher RSA levels (i.e., greater emotion regulation capacity).

4. Discussion

The descriptive data from this study highlights the extensive trauma histories and high symptoms of distress (e.g. 68% screen positive for PTSD) among women in community outpatient treatment for substance use disorders. The sample characteristics call attention to the overall low social economic status (SES) of these women – as evident in the low education, lack of employment and income, and dependence on medicaid or medicare for health care services. Particularly troubling is the overall low level of past mental health care given their trauma backgrounds and the high prevalence of co-morbid mental health conditions, based on the diagnostic screening results. This, combined with the fact that the majority were single mothers of dependent children and of these, 31% had CPS involvement, suggests the overwhelming need for skills to bolster emotion regulation capacity and societal/environmental resources – such as comprehensive mental health care – to support these women in their SUD treatment.

With two exceptions, the correlations between self-reported outcomes were significant and moderately correlated. The exceptions were the lack of relationship between trauma symptoms and interoceptive awareness, and the lack of relationship between substance use and the health outcome measures (trauma and depression symptoms, interoceptive awareness and mindfulness skills). Overall substance use was relatively low in this sample, largely due to high engagement in the SUD treatment program, likely contributing to the lack of association between substance use and health outcomes.

This study was the first to test the association between RSA, self-reported health outcomes of psychological distress, interoceptive awareness and mindfulness skills, and biochemical substance use among women engaged in SUD treatment. The study findings only partially supported the hypothesized results. As expected, interoceptive awareness was strongly associated with resting RSA in the expected direction. Also as expected, due to the overall high abstinence in this sample, substance use was not correlated with RSA. However, contrary to expectations, RSA was not significantly associated with any measure of psychological distress, or with mindfulness skills. The lack of associations between RSA and measures of psychological symptoms contributes to a mixed literature linking RSA with specific psychiatric diagnoses (see e.g., (Yaptangco, Crowell, Baucom, Bride, & Hansen, 2015). This is likely due to the fact that many factors shape the emergence and maintenance of psychopathology and because biomarkers, such as RSA, rarely correlate with specific disorders (Beauchaine, Neuhaus, Brenner, & Gatzke-Kopp, 2008).

These results, the first we know of examining this relationship between interoceptive awareness and an autonomic nervous system indicator of emotion regulation, support prior neurobiological models and imaging research indicating the importance of interoceptive awareness for emotion regulation. Thus, in this sample these results suggest that higher RSA

is associated with the active behavioral process of using interoceptive awareness skills to promote emotion regulation.

There are several limitations to consider when interpreting the results of this research. This was a cross-sectional study, and correlations between measures cannot be used to make causal inferences. As a within-subjects study, with no healthy control comparison group as used in most RSA cross-sectional studies, we were limited in our ability to find associations with symptom measures or with substance use. Also, this community treatment study involved women only in the NW USA and thus the results may not generalize to men, to women with higher SES, or to women in other locales. This was the first women's SUD treatment study to measure interoceptive awareness using the MAIA or to measure RSA, thus there is a need for more research to determine if these findings are representative of women in community treatment. This sample also lived with significant hardship due to their low socio-economic status, which contributed to their overall lack of lifetime mental health support and thus they may be different from women with more resources. However, the high level of trauma exposure and psychological distress in this sample is typical of women in community SUD treatment in North America suggesting the generalizability of these findings for this population. Last, due to the high level of treatment engagement, we were not able to assess the relationship between substance use severity and RSA and this remains a question for future research.

In conclusion, the findings provide the first evidence of a positive significant relationship between interoceptive awareness and RSA among women in SUD treatment. Psychological symptoms and mindfulness skills were not associated with RSA in this sample. More research is needed to determine whether RSA is modifiable in response to an intervention designed to improve interoceptive awareness among women in SUD treatment; the future results of this RCT are expected to answer this question. Meanwhile this study served as an important first step to examine the relationship between RSA and these health outcomes in SUD treatment research. The results suggest the possible use of biomarkers such as RSA to enhance our understanding of treatment mechanisms that target interoceptive awareness, particularly relevant for the clinical care of complex and highly distressed SUD populations such as these women in community treatment.

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Table 1.

Demographics and Health of Women in Chemical Dependency Treatment (N =217)

Variables	N	%
Age (median, range)	217	35, 20–61
Race		
African American	9	4.1%
Asian	3	1.4%
Native Hawaiian	1	0.5%
Native American	9	4.1%
White	164	75.6%
Mixed Race	22	10.1%
Other (filled in ethnicity etc.)	9	4.1%
Ethnicity		
Hispanic	20	10.0%
Highest Education Level		
11th grade or less	38	17.8%
High school or GED	91	42.5%
Two years college/technical school	70	32.7%
College degree (e.g., BA, BS)	15	6.9%
Monthly Income		
No monthly income	109	50.7%
Less than \$200	21	9.8%
Between \$200-\$1000	60	28%
\$1000 or more	25	11.6%
Children under 18 years of age	149	68.7%
Marital Status		
Married	14	6.5%
Divorced or Separated	66	30.4%
Single	113	52.3%
Domestic partnership	15	6.9%
Other	8	3.7%
Currently Employed	32	14.7%
Permanent Housing	118	54.9%
Health Insurance		
Medicaid	154	71.0%
Medicare	34	15.7%
Private	14	6.4%
None	7	3.2%
Court-Involvement	115	53%
Comorbid Mental Health Indicators		

Variables	N	%
PTSD (>screen cutoff)	148	68%
Depression (>screen cutoff, moderate depression)	74	34%
BMI (mean, range)	216	27.8, 17.6–47.2
BMI <18.5	2	<1%
BMI >25.0	143	66%

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Table 2.

Frequency and Percent of Reported Interpersonal Trauma History

Type of Interpersonal Trauma	N	% of Total
Any reported traumatic event	217	100%
Childhood Abuse (Physical and/or Sexual)	163	75%
Childhood Sexual Abuse	102	47%
Childhood Physical Abuse	88	41%
Adult Physical Assault (by stranger)	87	40%
Adult Intimate Partner Violence	181	83%
Adult Sexual Assault	85	39%
Adult Stalking	125	58%

Table 3.

Means, Standard Deviations and Range of Self-Report Measures: Substance Use, Psychological Symptoms, Interoceptive Awareness and Mindfulness Skills

Construct (Measure)	M	SD	Scale Range
Days Abstinent from Substance Use (TLFB)	72.54	22.42	0–90
Trauma (PSS-SR)	19.25	12.59	0–51
Difficulty with Emotion Regulation (DERS)	85.35	25.71	35–160
Depression (BDI)	15.14	10.22	0–53
Interoceptive Awareness (MAIA)	2.50	0.86	0–5
Mindfulness Skills (FMQ)	35.96	9.16	14–56

Table 4.**Bivariate Associations among Self-Report Measures**

Construct (Measure)	TFLB	PSS-SR	DERS	BDI	MAIA	FMQ
Substance Use (TFLB)	1	−0.09	−0.09	−0.11	0.03	−0.10
Trauma Symptoms (PSS-SR)	−0.09	1				
Emotion Dysregulation (DERS)	−0.04	0.51 ***	1			
Depression (BDI)	−0.11	0.60 ***	0.66 ***	1		
Interoceptive Awareness (MAIA)	0.03	−0.10	−0.43 ***	−0.29 ***	1	
Mindfulness (FMQ)	−0.10	−0.32 ***	−0.64 ***	−0.57 ***	0.56 ***	1

Note. Values are Pearson product-moment correlation.

*
p < .05

**
p < .01

p < .001

Table 5:

Multiple Regression Analysis: Associations between Resting RSA and Psychological Symptoms, Interoception, Mindfulness and Substance Use Adjusted for Age and BMI

Construct (Measure)	Regression Coefficient (B)	95% CI	t value	P
Trauma Symptoms (PSS-SR)	0.01 (0.09)	−0.01 to 0.03	1.17	.24
Difficulty w/Emotion Regulation (DERS)	−0.00 (−0.05)	−0.01 to 0.01	−0.52	.60
Depression (BDI)	−0.02 (−0.12)	−0.04 to 0.01	−1.24	.22
Interoception (MAIA)	0.28 (0.16)	0.03 to 0.53	2.19	.03
Mindfulness Skills (FMQ)	−0.01 (−0.08)	−0.04 to 0.02	−0.82	.41
Substance Use (Biochemical)	0.29 (0.08)	−0.18 to 0.77	1.22	.22
Age	−0.07 (−0.50)	−0.09 to −0.06	−8.22	< .001
BMI	−0.03 (−0.12)	−0.06 to 0.00	−1.96	.051

Note. Regression coefficients are unstandardized values with standardized beta values in parentheses. $F(8,193) = 10.94$, $P = < .001$. $R^2 = 0.31$. Adjusted $R^2 = 0.28$.