

Health Outcomes Following Childhood Maltreatment: An Examination of the Biopsychosocial Model

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Abstract

Child maltreatment constitutes a notoriously large problem within the healthcare field and is associated with significant biological, psychological, and social consequences across the lifespan. **Objectives:** The primary aim of this study was to examine the biopsychosocial outcomes of an adult population who reported a history of child maltreatment. **Method:** Data from the Midlife Development in the United States 2 Biomarker Project were used. The analytic sample in the present study included 1228 adults. AMOS 23 was used to conduct structural equation modeling and fit two separate models in order to examine the relationships between childhood maltreatment and biopsychosocial variables for both men and women. **Results:** Childhood maltreatment had a direct association with cortisol levels, subjective well-being, positive life events, depression, and physical symptoms and conditions for both men and women. **Discussion:** The present study offers unique contributions toward the examination of biopsychosocial outcomes following maltreatment. Practical implications and future directions are addressed.

Keywords

childhood maltreatment, biopsychosocial model, adult health, midlife development in the United States

Child maltreatment constitutes a notoriously large problem within the healthcare field (Anda et al., 2010). There have been a multitude of studies examining the lasting negative effects of trauma related to development (Cicchetti et al., 2010), mental health (Infurna et al., 2016; Mandelli et al., 2015), and general well-being and health (Felitti et al., 2019). Extant literature has established the detrimental effects of the occurrence of childhood maltreatment and abuse on biological, psychological, and social health (Barker et al., 2015; Hughes et al., 2017); however, there remains a need to further explore the association between childhood maltreatment on the biopsychosocial health of adult populations. It is imperative to understand not only the immediate systemic health effects of childhood maltreatment but also the enduring impact it has on mental and physical health outcomes for aging adults.

Applying the Biopsychosocial Model to Childhood Maltreatment

The biopsychosocial model was developed to bridge the gap between biological and psychological needs that had been traditionally treated dichotomously (Engel, 1980). Since its development, there has been a plethora of literature validating this theoretical approach when examining health outcomes

(Barker et al., 2015; Engel, 1980; Kaufman et al., 1997; McLaughlin et al., 2014; Woods, 2019). This model emphasizes the complexity of holistic health (Woods, 2019). This model, based on a system theory foundation, asserts that social, psychological, and physical health symptoms and conditions are causally influenced by each other (Woods, 2019). Furthermore, this model offers a unique insight into understanding the complexity of health issues because it accounts for these three facets of health and their mutual influence on the effectiveness of treatment (Engel, 1980; Woods, 2019). Scholars have demonstrated the need to simultaneously examine the biological, social, and psychological outcomes for individuals with a history of childhood maltreatment (Barker et al., 2015; Coates, 2010). Examining the impact of childhood maltreatment for aging adult individuals through a biopsychosocial model can deepen our understanding of the complex and varied impacts of maltreatment throughout the life span.

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Biological Impact of Maltreatment

There has been increasing evidence of the deleterious effects of childhood maltreatment on physiological symptoms throughout the life span (Felitti et al., 2019; Herrenkohl et al., 2016; Hughes et al., 2017). Repeated stress and trauma, including maltreatment, impact brain development and functioning which control regulatory responses (Bremner, 2006; McEwen, 1998). When an individual encounters stress, the brain releases neuromodulators as a part of an adaptive process (allostasis); however, when dealing with chronic stress like childhood maltreatment, this process leads to the gradual decline and degeneration of neural processes (allostatic load) that impact the hippocampus (McEwen, 1998). Extant literature has demonstrated the impact of maltreatment on the adult hippocampus, which is an important part of the limbic system that is a cortical region that regulates motivation, emotion, learning, and memory (Teicher et al., 2016). Additionally, maltreatment is associated with detrimental effects on the autonomic nervous system and natural stress reactions in maltreated individuals, including decreased restricted cardiac output reactivity and dysregulated patterns of physiological reactivity (McLaughlin et al., 2014). The impact of chronic stress and maltreatment on specific regions of the brain, and in turn the regulatory processes of the autonomic nervous system, leads to an increased allostatic load (Barker et al., 2015; Danese & McEwen, 2012; Hughes et al., 2017).

Several studies have asserted that childhood maltreatment triggers hypothalamic–pituitary–adrenal (HPA) axis reactivity (Cicchetti et al., 2010; Heim et al., 2000), increased cortisol levels (MacMillan et al., 2009), and elevated adrenocorticotrophic hormone reactivity (Kaufman et al., 1997). Dysregulated cortisol levels and dehydroepiandrosterone (DHEA-S) have, in turn, been associated with a myriad of health problems, including high blood pressure, mood changes, weight gain, and overactive adrenal gland responses (Cicchetti et al., 2010; Heim et al., 2000; Jardim et al., 2018; Kaufman et al., 1997; Read et al., 2001). Cicchetti et al. (2010) asserted that while there is a clear link between child maltreatment and dysregulated HPA, it remains unclear whether maltreatment will significantly elevate or suppress reactivity. Despite the mixed finding on the directionality of the relationship between maltreatment and the HPA axis, it remains clear that both direct and indirect impacts of maltreatment on the biopsychosocial processes need further exploration and validation (Cicchetti et al., 2010; Heim et al., 2000).

When examining the associations between childhood maltreatment and biopsychosocial variables, it should also be noted that physiological characteristics associated with sex hormones are important contributing factors. While the present study will address physiological characteristics associated related sex hormones as male and female, it is important to note that male and female do not describe the full spectrum of human sex, as sex is a social construct that relates

to anatomy and physiology. Dysregulated cortisol levels and dehydroepiandrosterone is an androgen, or male-type, hormone. While this hormone is produced in both men and women, it is common for men to produce naturally higher levels of DHEA-S. Healthy men tend to have DHEA-S around 4.64 $\mu\text{mol/L}$, while healthy women tend to be around 3.23 $\mu\text{mol/L}$; however, these levels escalate when individuals are exposed to psychosocial stress (Lennartsson et al., 2012). Furthermore, researchers have indicated significant sex differences when analyzing hormone levels, including DHEA-S and cortisol levels, in relation to childhood maltreatment (Cicchetti et al., 2010; Heim et al., 2000; Jardim et al., 2018). Similar differences in sex have been found when examining mental health outcomes in individuals who have a history of childhood maltreatment (Gallo et al., 2018). This combined evidence supports the need to separately examine biopsychosocial outcomes following childhood maltreatment in men and women.

Psychological Effects of Maltreatment

A plethora of evidence has been found linking the effects of child maltreatment to increased mental health symptoms and conditions in both clinical and general populations (Infurna et al., 2016; Mandelli et al., 2015; Schafer & Ferraro, 2013). Specifically, child maltreatment has been associated with increased post-traumatic stress disorder, anxiety, depression, suicidality, and psychosis (Infurna et al., 2016; Mandelli et al., 2015; Raposo et al., 2014). The influence of childhood maltreatment has been related to these mental health symptoms and conditions well into older adulthood (Raposo et al., 2014). There has also been extensive investigation into the impact of childhood maltreatment on neuroendocrine functioning or the system of interactions between the brain, nervous system, and hormone levels as well (Coates, 2010; Wilkinson & Goodyer, 2011). Extant literature has suggested that long-term psychological impacts, such as depressive disorders, are caused by disruptions in the neuroendocrine system (Wilkinson & Goodyer, 2011), providing a strong link between biological and psychological health. Adults with childhood maltreatment also tend to have decreased gray matter volume in their hippocampus and increased gray matter volume in their dorsomedial prefrontal cortex (DMPFC) and the orbitofrontal cortex (OFC), which are also emotional and mental regulator systems and increase their risk of developing major depressive disorders (Chaney et al., 2014). These effects, as well as the presence of mental health symptoms, can contribute to weakened social relationships as social difficulties and mental health symptoms are often comorbid (Barker et al., 2015).

Social Effects of Maltreatment

Child maltreatment also has the potential to disrupt long-term relational health and well-being (Dion et al., 2019; Lo et al.,

2019; Widom et al., 2018). Individuals with a history of maltreatment are more likely to have long-term attachment difficulties (Lo et al., 2019), to have higher risk of experiencing intimate partner violence and victimization (Caron et al., 2018), and to have greater difficulty forming attachments and developing social competence (Lo et al., 2019). One recent study found that adults who reported a history of childhood trauma experienced decreased life satisfaction and a significantly lower sense of social well-being (Mosley-Johnson et al., 2019). However, individuals who are capable of developing stable, supportive relationships as adults tend to experience reduced negative mental and physical outcomes following childhood maltreatment (Widom et al., 2018).

Scholars have attributed the impact of child maltreatment on relational functioning, in part, to the early influence of child maltreatment on psychological and neural development that influences attachment and relational skills (Demers et al., 2019). Evidence has supported the fact that the interaction between parent–child relationship quality and maltreatment can impact the frontal lobe volume in adulthood, which is the epicenter of emotion and higher-order thinking, decision-making, and impulse control (Demers et al., 2019). Additionally, this can contribute to later life mental health symptoms and interpersonal competence (Demers et al., 2019). This highlights the interconnection between biological and social development that lays the foundation for future physical and mental health outcomes. Additionally, how individuals respond to and engage in various social situations is, in part, dependent on their autonomic nervous system and hypo-/hyperarousal. Individuals with a history of childhood maltreatment experience a shift in their ability to form secure attachments and engage with others socially (Dion et al., 2019; Lo et al., 2019), which is a by-product of the neural, anatomical shifts within the brain that have been wired to be more sensitive to signs of threatening behaviors or social danger. When the emotions are regulated, a person can better engage in social situations and build meaningful connections. However, emotional dysregulation characterized by either hypo-arousal (shutting down) or hyperarousal (anxious) can contribute to social disengagement that would otherwise contribute to positive life events and have the potential to improve one's quality of life (Porges, 2011). This body of research provides further evidence of the interconnectedness of biological, psychological, and social factors following childhood maltreatment.

The Biopsychosocial Model for Adult Health

When studies have employed a biopsychosocial model to examine the link between child maltreatment and systemic adult health, their models yielded significant results that provided valuable insight into understanding the multitude of factors that influence an individual's well-being (McLaughlin et al., 2014). Additionally, the link between

child maltreatment and biopsychosocial outcomes has been established with nationally representative samples (Jardim et al., 2018; Mosley-Johnson et al., 2019; Raposo et al., 2014). Specifically, adults with a history of maltreatment are at an increased risk of mood and personality disorders such as depression, lower quality of life and subjective well-being, and overall poor physical health (Jardim et al., 2018; Mosley-Johnson et al., 2019; Raposo et al., 2014). The Midlife Development in the United States (MIDUS) studies were intended to delineate the biopsychosocial pathways through which interconnected biological, psychological, and social processes contribute to health outcomes. Given the limited amount of research examining the relationship between childhood maltreatment and health outcomes in an older population, this study sought to expand extant literature by further exploring the impact of child maltreatment on biological, mental health, and social outcomes by testing the biopsychosocial model with a sample of older adults with a history of maltreatment.

Present Study

The first aim of this study was to examine the relationship between retrospective reports of childhood maltreatment and biopsychosocial outcomes for adult men and women, while controlling for age. Given that men tend to have naturally higher levels of DHEA-S, men and women were examined separately in order to explore potential differences in results. We hypothesized that childhood maltreatment would be associated with all the biopsychosocial variables at a bivariate level for both men and women (Hypothesis 1 [H1]). We also hypothesized that abuse and neglect would have a direct association with each of the biopsychosocial variables for both men and women (Hypothesis 2 [H2]). The second aim of this study was to examine the relationship between several of the biopsychosocial factors for both men and women while accounting for participant age. Specifically, we hypothesized that the HPA axis would be related to increased rates of physical health symptoms/conditions and depression in both men and women (Hypothesis 3 [H3]). We hypothesized that subjective well-being and positive life events would be associated with decreased depression and physical health symptoms and conditions in both men and women (Hypothesis 4 [H4]). We hypothesized that depression would be associated with increased rates of physical health symptoms and conditions and depression in both men and women (Hypothesis 5 [H5]). Finally, given the cross-sectional nature of the data, the third aim of this study was to examine the hypothetical mediation of the two models while controlling for participant's age. We hypothesized that depression would partially mediate the association between childhood maltreatment and physical symptoms and conditions (Hypothesis 6 [H6]). Last, we hypothesized that depression would partially mediate the associations between subjective well-being and positive life events on physical health symptoms (Hypothesis 7 [H7]).

Method

Cross-sectional data from the National Survey of MIDUS 2 Biomarker Project were used (Ryff et al., 2012). The Biomarker Project included participants who completed the bi-oidicators and health protocol, with the broad aim of examining the biopsychosocial pathways that contribute to health outcomes (Love et al., 2010). The Biomarker Project contains 1255 respondents who initially participated in MIDUS 2 and includes indicators of the HPA axis, the autonomic nervous system, the immune system, the cardiovascular system, the musculoskeletal system, antioxidants, and metabolic processes functioning. Data were collected at three clinical research centers (UCLA, University of Wisconsin, and Georgetown University). All sites used common protocols approved by their Institutional Review Boards (IRBs). The analytic sample in this study included adults ($n = 1228$) between the ages of 34–83 years ($M = 56$) who reported a history of childhood maltreatment. The sample was predominantly white/Caucasian (78%) and female (57%). Over half of the participants were married (69%), had some post-high school training or less (42%), and had a mean annual income of \$41,538.

Measures

Childhood Maltreatment

The Childhood Trauma Questionnaire (CTQ; Bernstein et al., 1994) is a 28-item instrument that assesses the history of sexual, physical, and emotional abuse, as well as physical and emotional neglect that occurred prior to the age of 18 years. Sample items include “People in my family called me things like,” “People in my family hit me so hard that it left me with bruises or marks,” and “Someone tried to touch me in a sexual way or tried to make me touch them.” Items were scored using a 5-point Likert scale, ranging from (1) “never true” to (5) “very often true.” Items were averaged, such that higher means indicated higher rates of abuse and neglect (male, $\alpha = .93$; female, $\alpha = .94$).

Physical Symptoms and Conditions

The Symptoms and Conditions Checklist (SCC; Ryff et al., 2012) was a project-developed checklist used to assess overall health problems. This 20-item, self-report checklist provided a comprehensive medical history of heart disease, high blood pressure, circulation problems, blood clots, heart murmur, transient ischemic attack (TIA) or stroke, anemia or other blood disease, cholesterol problems, diabetes, asthma, alcoholism, broken bones/head injuries, and major surgeries. Sample items include “Has a physician diagnosed high blood pressure” and “have you ever had TIA or stroke?” Responses included (0) “no” and (1) “yes.” The total sum of symptoms and conditions was used, with higher scores indicating overall worse health.

Hypothalamic–pituitary–adrenal Axis

Two biomarkers were used to assess the hypothalamic–pituitary–adrenal axis, including urine cortisol levels and blood content of DHEA-S. Enzymatic colorimetric assay and liquid chromatography–tandem mass spectrometry (LC-MS/MS) are used for urine free, random, cortisol/cortisone assay (Taylor et al., 2002). Cortisol was extracted from the specimens using online turbulent-flow HPLC and analyzed by liquid chromatography–tandem mass spectrometry using multiple reaction monitoring in the positive mode. Fasting blood samples were collected from each participant before breakfast on day 2 of their hospital stay to measure DHEA-S; assay was performed with a Roche Modular Analytics E170 analyzer. Dysregulated cortisol levels and dehydroepiandrosterone was measured in micrograms of lead per deciliter of blood ($\mu\text{g}/\text{dL}$) and converted to micromolar ($\mu\text{mol}/\text{L}$).

Depression

The Center for Epidemiologic Studies Depression (CES-D; Radloff, 1977) is a 20-item, self-report measure that was used to assess for depression. Sample items include “I felt that I could not shake off the blues even with help from my family or friends” and “I thought my life had been a failure.” Items were scored on a 4-point Likert scale, ranging from (0) “rarely or none of the time” to (3) “most or all of the time.” Items 4, 8, 12, and 16 were reverse scored and then averaged, such that higher scores indicated greater depressive symptoms (male, $\alpha = .90$; female, $\alpha = .90$).

Subjective Well-being

The Satisfaction with Life Scale (SLS; Pavot & Diener, 1993) is a 5-item, self-report measure that was used to assess subjective well-being. Sample items include “In most ways, my life is close to my ideal” and “I am satisfied with my life.” Items were scored using a 7-point Likert scale, ranging from (1) “strongly disagree” to (7) “strongly agree.” Items were averaged, such that higher scores indicated greater subjective well-being (male, $\alpha = .89$; female, $\alpha = .87$).

Positive Life Events

The Pleasant Event Scale (PES; MacPhillamy & Lewinsohn, 1982) was utilized to assess social well-being. This 49-item self-reported measure evaluates the level of enjoyment an individual experienced related to recent positive life events over the past month. Sample items include “Having a frank and open conversation,” “Seeing good things happen to family and friends,” and “Being with someone I love.” Items were scored using a 3-point Likert scale, ranging from (1) “neutral or unpleasant” to (3) “very enjoyable.” Items were averaged, such that higher scores indicated more positive life events (male, $\alpha = .91$; female, $\alpha = .91$).

Table 1. Bivariate Associations between Maltreatment, Biopsychosocial, and Control Variables for Men.

	1	2	3	4	5	6	7	8
1. Child maltreatment (CTQ)	1.00							
2. Physical symptoms and conditions	.11*	1.00						
3. Depression (CES-D)	.29**	.18**	1.00					
4. Subjective well-being (SLS)	-.10*	-.05	-.44**	1.00				
5. Positive life events (PES)	-.27**	-.05	-.60**	.44**	1.00			
6. Urine cortisol	-.11*	-.19**	-.05	.01	-.02	1.00		
7. Blood DHEA-S	.09*	-.28**	.09*	-.06	-.11*	.06	1.00	
8. Age	-.17**	.45**	-.15**	.05	.23**	-.07	-.49**	1.00
Mean	1.33	3.66	8.21	2.23	4.79	1.20	6.39	55.13
SD	.45	2.57	7.77	.26	1.31	1.04	4.20	11.98
Skewness	2.30	1.06	1.76	-.35	-.68	3.28	1.54	.37
Kurtosis	12.21	1.79	4.29	-.18	-.04	21.07	4.50	-.61

Note. DHEA-S = dysregulated cortisol levels and dehydroepiandrosterone; SD = standard deviation. * $p < .05$, ** $p < .01$.

Table 2. Bivariate Associations between Maltreatment, Biopsychosocial, and Control Variables for Women.

	1	2	3	4	5	6	7	8
1. Child maltreatment (CTQ)	1.00							
2. Physical symptoms and conditions	.16**	1.00						
3. Depression (CES-D)	.31**	.23**	1.00					
4. Subjective well-being (SLS)	-.14**	-.06	-.38**	1.00				
5. Positive life events (PES)	-.27**	-.14**	-.50**	.43**	1.00			
6. Urine cortisol	-.08*	-.11**	-.00	-.06	-.03	1.00		
7. Blood DHEA-S	.08*	-.23**	.08*	-.02	-.05	.06	1.00	
8. Age	-.15**	.32**	-.15**	.03	.11**	-.10*	-.40**	1.00
Mean	1.48	4.07	8.63	2.24	4.80	1.09	5.04	54.58
SD	.57	2.92	8.17	.25	1.30	1.13	3.72	11.67
Skewness	2.44	1.09	1.62	-.40	-.62	4.56	1.72	.35
Kurtosis	6.98	1.70	3.22	-.01	-.15	38.43	5.39	-.61

Note. DHEA-S = dysregulated cortisol levels and dehydroepiandrosterone; SD = standard deviation. * $p < .05$, ** $p < .01$.

Statistical Analysis

SPSS 25 was used to evaluate bivariate associations, means, and SDs of childhood maltreatment and the observed biopsychosocial variables, as well as to examine skew and kurtosis (see Table 1). AMOS 23, an extension program of SPSS, was used to fit two structural equation models (SEMs) to examine the relationships between maltreatment and biopsychosocial variables. The SEM allows for all observable variables to be modeled simultaneously, making this an ideal model to test the biopsychosocial model in an adult population who reported a history of childhood maltreatment. Standardized beta coefficients (β) were evaluated to determine the magnitude, directionality, and significance of pathways (Yuan & Bentler, 2006). Three goodness-of-fit indices were used: the χ^2/df ratio, comparative fit index (CFI), and root-mean-square error approximation (RMSEA). An χ^2/df ratio below or near 3.0 indicates acceptable model fit (Carmines & McIver, 1981). A CFI value of .95 or greater indicates good model fit (Hu & Bentler, 1999). Finally, an

RMSEA value at or below .08 indicates good model fit (Hu & Bentler, 1999). Cases that had 50% or greater missing data were removed from the present analysis, and full information maximum likelihood estimations were used to account for missing data. Hypothetical mediation was examined by utilizing bias-corrected bootstrapping (Yuan & Bentler, 2006). Indirect effects were obtained by conducting 2000 bootstrap replicates and running for bias-correction confidence intervals. Age was the primary control variable included in both models to account for the effects of chronological aging on mental and physical health (Table 2).

Results

Descriptive statistics and bivariate correlations are provided in Table 1. Examination of skew and kurtosis indicated the data were normally distributed; however, there was high skew and kurtosis for urine cortisol levels for women (Mardia, 1970). The sample was predominantly Caucasian/white (76.1%) and female (56.8%). When examining experiences

of childhood maltreatment, over half the sample reported experiences of emotional abuse (60.9%; $M = 8.05$; $SD = 4.21$), physical abuse (59.5%; $M = 6.99$; $SD = 3.06$), emotional neglect (77.5%; $M = 9.77$; $SD = 4.57$), and physical neglect (51.4%; $M = 6.91$; $SD = 2.77$). A smaller portion of the sample reported experiences of sexual abuse (23%; $M = 6.61$; $SD = 3.98$). The overall average, which ranged from 1 to 5, indicated moderate levels of childhood maltreatment for the analytic sample ($M = 1.67$; $SD = .61$). When examining women and men separately, women reported a slightly higher experience of childhood maltreatment ($M = 1.73$; $SD = .68$) than men ($M = 1.58$, $SD = .49$). For both men and women, the bivariate correlations indicated significant associations between abuse and nearly all biopsychosocial variables, providing partial support for H1. Specifically, childhood maltreatment was related to decreased enjoyment in recent positive life events, decreased cortisol and increased DHEA-S, and increased physical health symptoms and conditions and depression.

Biopsychosocial Outcomes for Men

Figure 1 presents the full structural model that was fitted to examine the association of childhood maltreatment to all observable biopsychosocial variables for men. Model fit was good (χ^2/df ratio = .48; CFI = 1.00; RMSEA = .00, CI [.00, .04]). Childhood maltreatment had a significant negative association with subjective well-being and positive life events, such that those who reported a history of childhood maltreatment were more likely to report decreased life

satisfaction and less enjoyment in recent positive events. Childhood maltreatment had a significant positive association with depression and physical symptoms and conditions, such that those who reported a history of maltreatment were more likely to report increased depressive symptoms and health problems. Finally, maltreatment had a significant negative relationship with cortisol levels, but not DHEA-S, such that those who reported a history of maltreatment had partially suppressed HPA axis reactivity. These associations provided partial support for H2.

When examining the relationships between the biopsychosocial variables for men, cortisol and DHEA-S levels both had significant negative associations with physical symptoms and conditions, such that the HPA axis was associated with decreased health problems, failing to provide support for H3. Cortisol levels, but not DHEA-S, had a significant negative relationship with male depression, such that cortisol was associated with decreased depressive symptoms, failing to provide support for H3. Both subjective well-being and positive life events were negatively associated with male depression but not physical symptoms and conditions, such that individuals who reported higher life satisfaction and increased enjoyment in recent positive life events reported lower depressive symptoms, providing partial support for H4. Finally, depression had a significant positive relationship with physical symptoms and conditions, such that men who reported higher depressive symptoms tended to have increased health problems, providing support for H5.

Finally, the theoretical partial mediation effects of depression on physical symptoms and conditions were observed.

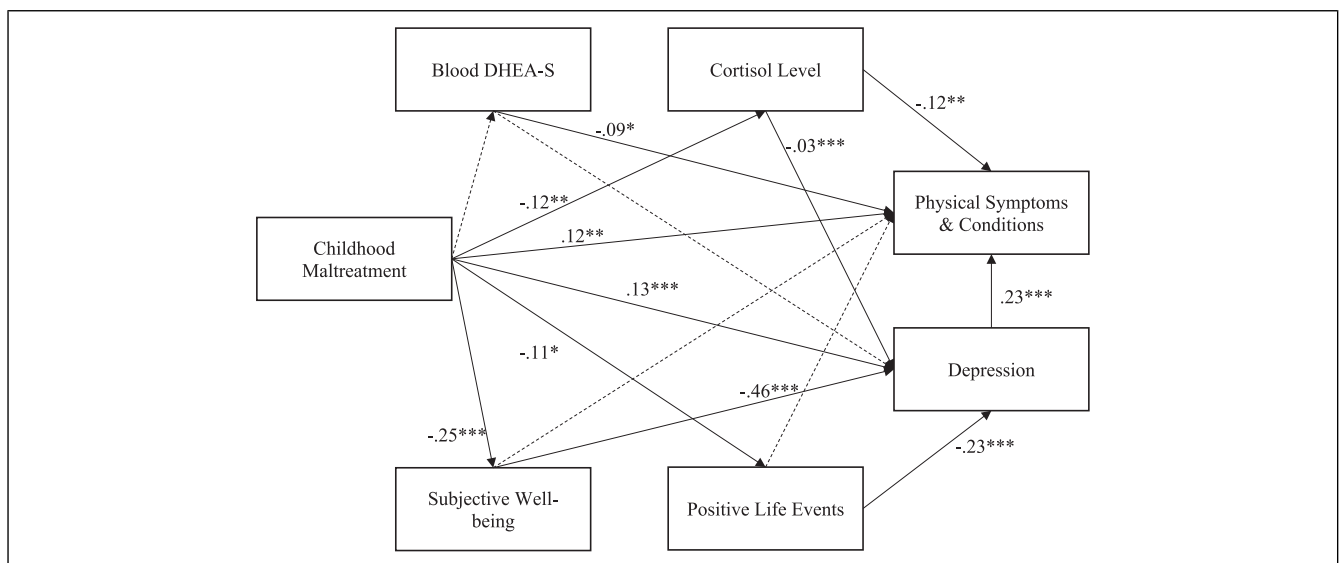


Figure 1. SEM model of maltreatment and biopsychosocial variables for adult men ($n = 542$). Note. SEM = structural equation modeling; DHEA-S = Dysregulated cortisol levels and dehydroepiandrosterone; CFI = comparative fit index; RMSEA = root-mean-square error approximation. * $p < .05$, ** $p < .01$, *** $p < .001$. Dashed lines indicate nonsignificant pathways. Age was controlled for but not depicted. The residual errors for subjective well-being and positive life events and DHEA-S and cortisol level were covaried. Standardized coefficients are presented. Fit statistics: χ^2/df ratio = .48; CFI = 1.00; RMSEA = .00, CI [.00, .04].

Depression partially mediated the relationship between childhood maltreatment and physical health symptoms and conditions ($\beta = .14$; $p < .01$; $SE = .02$; 95% CI [.10, .18]), providing support for H6. Specifically, higher symptoms of depression contributed to overall worse physical health outcomes for men. The relationship between subjective well-being and physical health symptoms and conditions was partially mediated by depression ($\beta = -.11$; $p < .01$; $SE = .03$; 95% CI [-.15, -.07]). Additionally, the relationship between positive life events and physical health symptoms and conditions was partially mediated by depression ($\beta = -.05$; $p < .01$; $SE = .01$; 95% CI [-.08, -.03]), providing partial support for H7. Specifically, increased life satisfaction and enjoyment in recent events contribute to decreased health problems for men.

Biopsychosocial Outcomes for Women

Figure 2 presents the full structural model that was fitted to examine the impact of childhood maltreatment on all observable biopsychosocial variables for women. Model fit was good (χ^2/df ratio = 1.02; CFI = .99; RMSEA = .01, CI [.06, .90]). Childhood maltreatment had a significant negative association with subjective well-being and positive life events, such that those who reported a history of childhood maltreatment were likely to report decreased life satisfaction and less enjoyment in recent positive events. Childhood maltreatment had a significant positive association with depression and physical symptoms and conditions, such that

those who reported a history of maltreatment were likely to report increased depressive symptoms and health problems. Finally, maltreatment had a significant negative relationship with cortisol levels but not DHEA-S, such that those who reported a history of maltreatment had partially suppressed HPA axis reactivity. These associations provided partial support for H2.

Next, the relationship between biopsychosocial variables was observed for women. Cortisol level, but not DHEA-S, had a significant negative association with physical symptoms and conditions, such that the HPA axis was partially associated with decreased health problems, failing to provide support for H3. Neither cortisol level nor DHEA-S had a significant relationship with depression for women, also failing to provide support for H3. Both subjective well-being and positive life events were negatively associated with female depression but not physical symptoms and conditions, such that individuals who reported higher life satisfaction and increased enjoyment in recent positive life events reported lower depressive symptoms, providing partial support for H4. Depression had a significant positive relationship with physical symptoms and conditions, such that women who reported higher depressive symptoms tended to have increased health problems, providing support for H5.

Finally, the theoretical partial mediation effects of depression on physical symptoms and conditions were observed. Depression partially mediated the relationship between childhood maltreatment and physical health symptoms and conditions ($\beta = .53$; $p < .01$; $SE = .02$; 95% CI [.09, .16]), providing support for

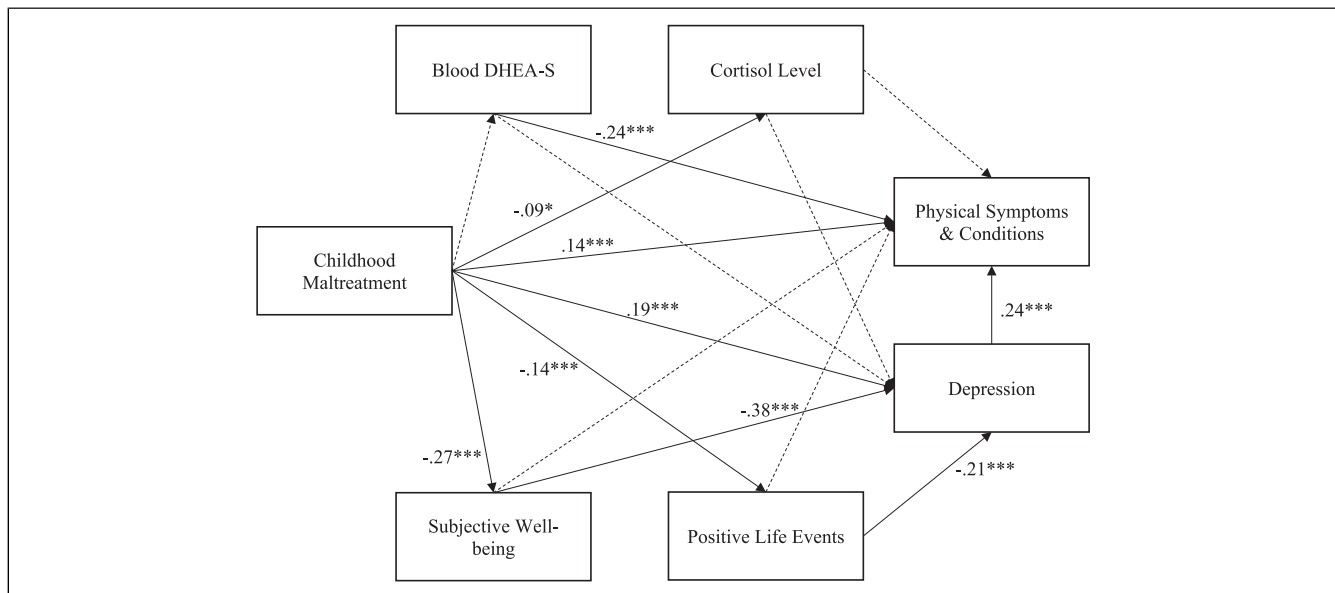


Figure 2. SEM model of maltreatment and biopsychosocial variables for adult women ($n = 686$). Note. SEM = structural equation modeling; DHEA-S = Dysregulated cortisol levels and dehydroepiandrosterone; CFI = comparative fit index; RMSEA = root-mean-square error approximation. *** $p < .001$, ** $p < .01$, * $p < .05$. Dashed lines indicate nonsignificant pathways. Age was controlled for but not depicted. The errors for subjective well-being and positive life events and DHEA-S and cortisol level were covaried. Standardized coefficients are presented. Fit statistics: χ^2/df ratio = 1.02; CFI = .99; RMSEA = .01, CI [.06, .90].

H6. Specifically, higher symptoms of depression contributed to overall worse physical health outcomes for women. The relationship between subjective well-being and physical health symptoms and conditions was partially mediated by depression ($\beta = -.08$; $p < .02$; $SE = .03$; 95% CI $[-.12, -.05]$). Additionally, the relationship between positive life events and physical health symptoms and conditions was partially mediated by depression ($\beta = -.05$; $p < .01$; $SE = .01$; 95% CI $[-.07, -.03]$), providing partial support for H7. Specifically, increased life satisfaction and enjoyment in recent events contribute to decreased health problems for women.

Discussion

The purpose of this study was to examine the biopsychosocial outcomes for adult men and women who had a history of childhood maltreatment. Our study adds to extant literature that explores the long-term effects of childhood trauma on long-term biopsychosocial health (Brown et al., 2009; Felitti et al., 2019). The present study offers unique contributions to our current understanding of the relationship between childhood maltreatment and biopsychosocial health outcomes as it captures three distinct, yet interwoven facets of health. As demonstrated, childhood maltreatment had a direct association with cortisol levels, subjective well-being, positive life events, depression, and physical symptoms and conditions for both men and women. This aligns with previous work that has validated the link between childhood adversity and overall biological, psychological, and social health outcomes (Brown et al., 2009; Felitti et al., 2019; Hughes et al., 2017; Infurna et al., 2016). However, when examining the overall findings, it should be noted that the strongest associations are between age, depressive symptoms, subjective well-being, and positive life events. This suggests that while childhood maltreatment is an important factor that should be considered when examining health across multiple spheres, other contextual factors including age influence the magnitude of these findings. With this in mind, the present study expands extant literature by validating a model that bridges biological and psychological needs and outcomes for a nationally representative sample of adults with a history of childhood maltreatment.

The findings from this study indicate that raised hormonal levels could contribute to these negative health outcomes, which align with previous research that has asserted that childhood maltreatment triggers hypothalamic–pituitary–adrenal (HPA) axis reactivity (Cicchetti et al., 2010; Heim et al., 2000), cortisol levels (MacMillan et al., 2009), and elevated adrenocorticotropic hormone reactivity (Kaufman et al., 1997). When examining DHEA-S specifically, the mean of the present analytic sample indicates escalated levels of DHEA-S per $\mu\text{mol/L}$. This aligns with previous work that has demonstrated that physiological stress is associated with escalated DHEA-S level that contributes to HPA axis

functioning (Lennartsson et al., 2012). Dysregulated cortisol levels and DHEA-S are also associated with increased allostatic load that impacts hippocampus function (McEwen, 1998) and leads to increased health problems, including high blood pressure, mood changes, weight gain, and overactive adrenal gland responses (Cicchetti et al., 2010; Heim et al., 2000; Kaufman et al., 1997; Jardim et al., 2018; Read et al., 2001). While maltreatment was only associated with dysregulated cortisol, and not DHEA-S, for both men and women, these findings still offer insight into one variable used to measure allostatic load and align with previous work that has demonstrated the association between maltreatment and increased allostatic load in adulthood (Danese & McEwen, 2012; Widom et al., 2015).

The present findings indicate that considering the influence of childhood maltreatment on long-term biological health is an important endeavor for scholars, clinicians, and medical professionals. For both men and women, it was observed that childhood maltreatment was associated with increased symptoms and conditions, including increased risk of heart disease, high blood pressure, circulation problems, blood clots, heart murmur, TIA or stroke, anemia or other blood disease, cholesterol problems, diabetes, asthma, alcoholism, broken bones/head injuries, and major surgeries. McLaughlin et al. (2014) concluded that maltreatment negatively impacts the autonomic nervous system, which can contribute to lower health outcomes and stress reactions in adults.

Findings regarding the influence of childhood maltreatment on social well-being assert that individuals who have early experiences of childhood trauma are more likely to experience decreased life satisfaction and enjoyment in recent positive life events. Similarly, those who reported increased life satisfaction and enjoyment in recent positive life events experienced decreased depressive symptoms. Both relationships reflect previous findings, which demonstrate that maltreatment has a direct influence on adult relationships (Caron et al., 2018; Widom et al., 2018), as well as an influence on mental and physical health outcomes (Demers et al., 2019; Hughes et al., 2017; Widom et al., 2018). Surprisingly, the present findings failed to support the associations between subjective well-being, positive life events, and physical health symptoms and conditions. However, this may be due to the fact that depression fully mediated the influence of subjective well-being and positive life events on physical health. These results partially align with previous work, which has found that adult attachment partially explains the relationship between maltreatment and mental and physical health outcomes (Widom et al., 2018). Both male and female depressive symptoms were related to increased physical symptoms and condition, reflecting previous meta-analytic work, which demonstrated the link between depression and somatic symptoms (Pan et al., 2011).

Cortisol played an important role in the physical symptoms and conditions and depression for men, but not women.

These findings suggest that men may be more prone to experiencing increased cortisol levels following early life trauma and that this dysregulation has a greater impact on their overall health in later life. DHEA-S levels had a stronger association with physical symptoms and conditions for women. While maltreatment did not contribute to the dysregulation of DHEA-S levels, DHEA-S dysregulation was still associated with physical health symptoms and conditions, and this was especially true for women. Finally, maltreatment had slightly stronger associations with physical symptoms and conditions, depression, subjective well-being, and positive life events for women. This suggests that childhood maltreatment may have a slightly more enduring effect on the overall well-being of women.

Limitations and Future Directions

The present findings should be interpreted within the context of the study limitations. First, data were cross-sectional, and therefore, causal inferences cannot be made, and mediational effects can only be interpreted as hypothetical. Future work should employ longitudinal data analysis when examining the mediating roles of biopsychosocial variables on physical and mental health outcomes in adult populations with a history of childhood maltreatment. Additionally, the present study relied on retrospective reports of child maltreatment, which are prone to recall bias and misclassification bias, limiting the generalizability to other studies. Next, although the model developed in this study provided good fit to the data, these results do not imply that the model has been proven; rather, the model has not been rejected in the current study (Yuan & Bentler, 2006). It should be noted that other models could provide equally valid explanations of the associations between the variables observed in the present study. Future studies could cross-validate this model with other samples and longitudinal data to ensure that the present results are not sample-specific. Finally, given the constraints of the DHEA-S being sex specific, it was important to test the models separately to examine potential sex differences and therefore not able to examine the moderating effect of sex. Additionally, MIDUS 2 does not include any information on intersex individuals, limiting our ability to examine how these relationships may change in relation to physiological characteristics and hormones for intersex individuals.

Practical Implications

Childhood maltreatment is a public health concern that needs to be surveyed. This study contributes to extant literature by supporting that the biopsychosocial model is a valid theoretical model that can be utilized to examine multiple facets of health. The results of this overall model validate previous findings that highlighted the importance of assessing biological, psychological, and social components of health in adults with a history of childhood maltreatment (Barker et al.,

2015; McLaughlin et al., 2014). The biopsychosocial model emphasizes the need for medical and mental health personnel to employ patient-centered and relationship-centered approaches in order to arrive at the correct health prognosis (Engel, 1980; Oral et al., 2016; Woods, 2019). Mental health practitioners and medical personnel should consider the systemic and mutual influence of early life trauma (i.e., maltreatment, abuse, and neglect), relational factors, mental health, and physical well-being when working with adult clients and patients. Additionally, these results suggest that regardless of an individual's age, assessing for the history of early life trauma is an important task of clinicians and medical personnel when understanding the variables that may be impacting a client's health (Anda et al., 2010).

While the magnitude of the relationship between childhood maltreatment and biopsychosocial factors is relatively small, maltreatment is still playing a significant role in the overall functioning of individuals well into adulthood. Similarly, previous findings have demonstrated that even though childhood maltreatment and misfortune are not the strongest predictor of health outcomes, the association between maltreatment and health outcomes also does not diminish in adulthood (Schafer & Ferraro, 2013). This aligns with foundational work conducted by Anda et al. (2010) that urge scholars and clinicians to consider the systemic impact of maltreatment across the life span. Therefore, it is important for medical and mental health providers to access information regarding early life trauma and maltreatment, even when working with adult populations. Additionally, this contributes to extant literature which highlights the importance of trauma-informed care across the life span. Knowing that maltreatment can lead to dysregulation from a biological, psychological, and social standpoint can help clinicians adopt a trauma-informed lens and more effectively select treatment options. These types of approaches are helpful in adapting mental and medical interventions that account for the impact of traumatic toxic stress and the impact it has on response system activation, including the HPA axis (Danese & McEwen, 2012; Dion et al., 2019).

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References

- Anda, R. F., Butchart, A., Felitti, V. J., & Brown, D. W. (2010). Building a framework for global surveillance of the public health implications of adverse childhood experiences. *American journal of preventive medicine*, *39*(1), 93-98. doi:10.1016/j.amepre.2010.03.015
- Barker, V., Gumley, A., Schwannauer, M., & Lawrie, S. M. (2015). An integrated biopsychosocial model of childhood maltreatment and psychosis. *The British Journal of Psychiatry*, *206*(3), 177-180. doi:10.1192/bjpp.113.143578
- Bernstein, D. P., Fink, L., Handelsman, L., & Foote, J. (1994). Initial reliability and validity of a new retrospective measure of child abuse and neglect. *American Journal of Psychiatry*, *151*(8), 1132-1136. doi:10.1176/ajp.151.8.1132
- Bremner, J. D. (2006). Traumatic stress: Effects on the brain. *Dialogues in clinical neuroscience*, *8*(4), 445-446.
- Brown, D. W., Anda, R. F., Tiemeier, H., Felitti, V. J., Edwards, V. J., Croft, J. B., & Giles, W. H. (2009). Adverse childhood experiences and the risk of premature mortality. *American Journal of Preventive Medicine*, *37*(5), 389-396. doi:10.1016/j.amepre.2009.06.021
- Carmines, E., & McIver, J. (1981). Analyzing models with unobserved variables: Analysis of covariance structures. In G. W. Bohrnstedt, & E. F. Borgatta (Eds.), *Social measurement: Current issues* (pp. 65-115). Sage Publications, Inc.
- Caron, A., Lafontaine, M. F., & Bureau, J. F. (2018). Exploring the relationship between child maltreatment, intimate partner violence victimization, and self-injurious thoughts and behaviors. *Journal of Aggression, Maltreatment & Trauma*, *27*(7), 759-776. doi:10.1080/10926771.2017.1410746
- Chaney, A., Carballedo, A., Amico, F., Fagan, A., Skokauskas, N., Meaney, J., & Frodl, T. (2014). Effect of childhood maltreatment on brain structure in adult patients with major depressive disorder and healthy participants. *Journal of Psychiatry & Neuroscience*, *39*(1), 50. doi:10.1503/jpn.120208
- Cicchetti, D., Rogosch, F. A., Gunnar, M. R., & Toth, S. L. (2010). The differential impacts of early physical and sexual abuse and internalizing problems on daytime cortisol rhythm in school-aged children. *Child Development*, *81*(1), 252-269. doi:10.1111/j.1467-8624.2009.01393.x
- Coates, D. (2010). Impact of childhood abuse: Biopsychosocial pathways through which adult mental health is compromised. *Australian Social Work*, *63*(4), 391-403.
- Danese, A., & McEwen, B. S. (2012). Adverse childhood experiences, allostasis, allostatic load, and age-related disease. *Physiology & behavior*, *106*(1), 29-39. doi:10.1016/j.physbeh.2011.08.019
- Demers, L. A., Handley, E. D., Hunt, R. H., Rogosch, F. A., Toth, S. L., Thomas, K. M., & Cicchetti, D. (2019). Childhood maltreatment disrupts brain-mediated pathways between adolescent maternal relationship quality and positive adult outcomes. *Child Maltreatment*, *24*(4), 424-434. doi: 10.1177/1077559519847770
- Dion, J., Gervais, J., Bigras, N., Blackburn, M. E., & Godbout, N. (2019). A longitudinal study of the mediating role of romantic attachment in the relation between child maltreatment and psychological adaptation in emerging adults. *Journal of Youth and Adolescence*, *48*(12), 2391-2402. doi:10.1007/s10964-019-01073-4
- Engel, G. L. (1980). The clinical application of the biopsychosocial model. *American Journal of Psychiatry*, *137*(5), 535-544. doi: 10.1176/ajp.137.5.535
- Felitti, V. J., Anda, R. F., Nordenberg, D., Williamson, D. F., Spitz, A. M., Edwards, V., Koss, M. P., & Marks, J. S. (2019). Relationship of childhood abuse and household dysfunction to many of the leading causes of death in adults: The adverse childhood experiences (ACE) study. *American Journal of Preventive Medicine*, *56*(6), 774-786. doi:10.1016/j.amepre.2019.04.001
- Gallo, E. A. G., Munhoz, T. N., de Mola, C. L., & Murray, J. (2018). Gender differences in the effects of childhood maltreatment on adult depression and anxiety: A systematic review and meta-analysis. *Child Abuse & Neglect*, *79*, 107-114. doi:10.1016/j.chiabu.2018.01.003
- Heim, C., Newport, D. J., Heit, S., Graham, Y. P., Wilcox, M., Bonsall, R., Miller, A. H., & Nemeroff, C. B. (2000). Pituitary-adrenal and autonomic responses to stress in women after sexual and physical abuse in childhood. *JAMA*, *284*(5), 592-597. doi: 10.1001/jama.284.5.592
- Herrenkohl, T. I., Leeb, R. T., & Higgins, D. (2016). The public health model of child maltreatment prevention. *Trauma, Violence, & Abuse*, *17*(4), 363-365. doi:10.1177/1524838016661034
- Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal*, *6*(1), 1-55. doi:10.1080/10705519909540118
- Hughes, K., Bellis, M. A., Hardcastle, K. A., Sethi, D., Butchart, A., Mikton, C., Jones, L., & Dunne, M. P. (2017). The effect of multiple adverse childhood experiences on health: A systematic review and meta-analysis. *The Lancet Public Health*, *2*(8), e356-e366. doi:10.1016/S2468-2667(17)30118-4
- Infurna, M. R., Reichl, C., Parzer, P., Schimmenti, A., Bifulco, A., & Kaess, M. (2016). Associations between depression and specific childhood experiences of abuse and neglect: A meta-analysis. *Journal of affective disorders*, *190*, 47-55. doi:10.1016/j.jad.2015.09.006
- Jardim, G. B. G., Novelo, M., Spanemberg, L., Von Gunten, A., Engroff, P., Nogueira, E. L., & Neto, A. C. (2018). Influence of childhood abuse and neglect subtypes on late-life suicide risk beyond depression. *Child abuse & neglect*, *80*, 249-256. doi:10.1016/j.chiabu.2018.03.029
- Kaufman, J., Birmaher, B., Perel, J., Dahl, R. E., Moreci, P., Nelson, B., Wells, W., & Ryan, N. D. (1997). The corticotropin-releasing hormone challenge in depressed abused, depressed non-abused, and normal control children. *Biological Psychiatry*, *42*(8), 669-679. doi:10.1016/S0006-3223(96)00470-2
- Lennartsson, A. K., Kushnir, M. M., Bergquist, J., & Jonsdottir, I. H. (2012). DHEA and DHEA-S response to acute psychosocial stress in healthy men and women. *Biological psychology*, *90*(2), 143-149. doi:10.1016/j.biopsycho.2012.03.003
- Lo, C. K., Chan, K. L., & Ip, P. (2019). Insecure adult attachment and child maltreatment: A meta-analysis. *Trauma, Violence, & Abuse*, *20*(5), 706-719. doi:10.1177/1524838017730579
- Love, G.D., Seeman, T.E., Weinstein, M., & Ryff, C.D. (2010). Bioindicators in the MIDUS national study: Protocol, measures, sample, and comparative context. *Journal of Aging Health*, *22*(8), 1059-1080. doi:10.1177/0898264310374355

- MacMillan, H. L., Georgiades, K., Duku, E. K., Shea, A., Steiner, M., Niec, A., Tanaka, M., Gensey, S., Spree, S., Vella, E., Walsh, C. A., De Bellis, M. D., Van der Meulen, J., Boyle, M. H., & Schmidt, L. A. (2009). Cortisol response to stress in female youths exposed to childhood maltreatment: Results of the youth mood project. *Biological Psychiatry*, *66*(1), 62-68. doi:10.1016/j.biopsych.2008.12.014
- MacPhillamy, D.J., & Lewinsohn, P.M. (1982). The pleasant events schedule: Studies on reliability, validity, and scale intercorrelation. *Journal of Consulting and Clinical Psychology*, *50*(3), 363-380. doi:10.1037/0022-006X.50.3.363
- Mandelli, L., Petrelli, C., & Serretti, A. (2015). The role of specific early trauma in adult depression: A meta-analysis of published literature. *European Psychiatry*, *30*(6), 665-680. doi:10.1016/j.eurpsy.2015.04.007
- Mardia, K. V. (1970). Measures of multivariate skewness and kurtosis with applications. *Biometrika*, *57*(3), 519-530. doi:10.2307/2334770
- McEwen, B. S. (1998). Stress, adaptation, and disease: Allostasis and allostatic load. *Annals of the New York Academy of Sciences*, *840*(1), 33-44. doi:10.1111/j.1749-6632.1998.tb09546.x
- McLaughlin, K. A., Sheridan, M. A., Alves, S., & Mendes, W. B. (2014). Child maltreatment and autonomic nervous system reactivity: Identifying dysregulated stress reactivity patterns using the biopsychosocial model of challenge and threat. *Psychosomatic medicine*, *76*(7), 538. doi:10.1097/PSY.0000000000000098
- Mosley-Johnson, E., Garacci, E., Wagner, N., Mendez, C., Williams, J. S., & Egede, L. E. (2019). Assessing the relationship between adverse childhood experiences and life satisfaction, psychological well-being, and social well-being: United States longitudinal cohort 1995–2014. *Quality of Life Research*, *28*(4), 907-914. doi:10.1007/s11136-018-2054-6
- Oral, R., Ramirez, M., Coohy, C., Nakada, S., Walz, A., Kuntz, A., Benoit, J., & Peek-Asa, C. (2016). Adverse childhood experiences and trauma informed care: The future of health care. *Pediatric research*, *79*(1), 227-233. doi:10.1038/pr.2015.197
- Pan, A., Sun, Q., Okereke, O., Rexrode, K., & Hu, F. (2011). Depression and risk of stroke morbidity and mortality: A meta-analysis and systematic review. *JAMA*, *306*(11), 1241-1249. doi:10.1001/jama.2011.1282
- Pavot, W., & Diener, E. (1993). Review of the satisfaction with life scale. *Psychological Assessment*, *5*(2), 164-172. doi:10.1037/1040-3590.5.2.164
- Porges, S. W. (2011). *The polyvagal theory: Neurophysiological foundations of emotions, attachment, communication, and self-regulation*. W. W. Norton.
- Radloff, L. S. (1977). The CES-D scale: A self-report depression scale for research in the general population. *Applied Psychological Measurements*, *1*, 385-401. doi:10.1177/014662167700100306
- Raposo, S. M., Mackenzie, C. S., Henriksen, C. A., & Afifi, T. O. (2014). Time does not heal all wounds: Older adults who experienced childhood adversities have higher odds of mood, anxiety, and personality disorders. *The American Journal of Geriatric Psychiatry*, *22*(11), 1241-1250. doi:10.1016/j.jagp.2013.04.009
- Read, J., Perry, B. D., Moskowitz, A., & Connolly, J. (2001). The contribution of early traumatic events to schizophrenia in some patients: A traumagenic neurodevelopmental model. *Psychiatry: Interpersonal and Biological Processes*, *64*(4), 319-345.
- Ryff, C.D., Almeida, D.M., Ayanian, J.S., Carr, D.S., Cleary, P.D., Coe, C., Davidson, R., Krueger, R.F., Lachman, M.E., Marks, N.F., Mroczek, D.K., Seeman, T., Seltzer, M.M., Singer, B.H., Sloan, R.P., Tun, P.A., Weinstein, M., & Williams, D. (2012). *National survey of midlife development in the United States (MIDUS 2), 2004-2006*. ICPSR04652-v6. Inter-University Consortium for Political and Social Research [Distributor]. doi:10.3886/ICPSR04652.v6
- Schafer, M. H., & Ferraro, K. F. (2013). Childhood misfortune and adult health: Enduring and cascading effects on somatic and psychological symptoms? *Journal of Aging and Health*, *25*(1), 3-28. doi:10.1177/0898264312464884
- Taylor, R. L., Machacek, D., & Singh, R. J. (2002). Validation of a high-throughput liquid chromatography–tandem mass spectrometry method for urinary cortisol and cortisone. *Clinical Chemistry*, *48*(9), 1511-1519.
- Teicher, M. H., Samson, J. A., Anderson, C. M., & Ohashi, K. (2016). The effects of childhood maltreatment on brain structure, function and connectivity. *Nature Reviews Neuroscience*, *17*(10), 652. doi:10.1038/nrn.2016.111
- Widom, C. S., Czaja, S. J., Kozakowski, S. S., & Chauhan, P. (2018). Does adult attachment style mediate the relationship between childhood maltreatment and mental and physical health outcomes?. *Child Abuse & Neglect*, *76*, 533-545. doi:10.1016/j.chiabu.2017.05.002
- Widom, C. S., Horan, J., & Brzustowicz, L. (2015). Childhood maltreatment predicts allostatic load in adulthood. *Child Abuse & Neglect*, *47*, 59-69. doi:10.1016/j.chiabu.2015.01.016
- Wilkinson, P. O., & Goodyer, I. M. (2011). Childhood adversity and allostatic overload of the hypothalamic-pituitary-adrenal axis: A vulnerability model for depressive disorders. *Development and Psychopathology*, *23*(4), 1017-1037. doi:10.1017/S0954579411000472
- Woods, S. B. (2019). Biopsychosocial theories. In B. H. Fiese, M. Celano, K. Deater-Deckard, E. N. Jouriles, & M. A. Whisman (Eds.), *APA handbook of contemporary family psychology: Foundations, methods, and contemporary issues across the lifespan* (pp. 75-92). American Psychological Association.
- Yuan, K. H., & Bentler, P. M. (2006). Structural equation modeling. *Handbook of Statistics: Psychometrics*, *26*, 297-358. doi:10.1016/S0169-7161(06)26010-3