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Complex PTSD symptoms mediate the association between childhood trauma and physical health problems

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Childhood trauma is pervasive across geographic and socioeconomic settings (Stoltenborgh, Bakermans-Kranenburg, Alink, & van Ijzendoorn, 2015), and its adult health sequelae are well-established (Afifi et al., 2016; Briere & Elliott, 2003). In addition to increasing the risk of psychopathology, these negative childhood experiences can have a lifelong impact on the biological system, leaving those affected at greater risk of physical morbidity and mortality (Felitti et al., 1998; Kalmakis & Chandler, 2015). Specifically, somatic problems and cardiovascular diseases (CVD), two physical health problems that constitute a substantial burden on healthcare systems worldwide, have been consistently linked with trauma exposure early in life. For example, many studies have shown that somatic problems, such as musculoskeletal pain, ear, nose, and throat symptoms, abdominal pain and gastrointestinal symptoms, fatigue, and dizziness are more common among adults with a history of childhood trauma compared to their non-traumatized counterparts (Davis, Luecken, & Zautra, 2005; Kirmayer, Groleau, Looper, & Dao, 2004; Nelson, Baldwin, & Taylor, 2012). These subjective, medically unexplained physical health problems often persist and present as functional somatic syndromes, such as fibromyalgia, chronic fatigue/pain, and irritable bowel syndrome (Mayou & Farmer, 2002), which account for 40-49% of patient complaints in primary healthcare settings (Haller, Cramer, Lauche, & Dobos, 2015). There is also evidence that CVD - a group of clinically observable pathological conditions that involve the heart and blood vessels, and the leading cause of death globally (World Health Organization, 2017) – are positively associated with exposure to childhood trauma, especially in the context of abuse and neglect (Basu, McLaughlin, Misra, & Koenen, 2017; Hughes et al., 2017).

While biological and behavioral mechanisms (e.g. increased inflammation and risky health-related behaviors, respectively) have explain some of the increased risk of physical health

problems following exposure to childhood trauma (Coelho, Viola, Walss-Bass, Brietzke, & Grassi-Oliveira, 2014; Rasmussen et al., 2019; Su, Jimenez, Roberts, & Loucks, 2015), psychological risk factors have also been identified. Most notably, there is evidence that posttraumatic stress disorder (PTSD) is associated with increased somatic problems (Brennstuhl, Tarquinio, & Montel, 2015; R. Campbell, M. R. Greeson, D. Bybee, & S. Raja, 2008; McKernan et al., 2019; Milligan-Saville et al., 2017; Morina, Schnyder, Klaghofer, Muller, & Martin-Soelch, 2018; A. Powers et al., 2014; Raphael & Widom, 2011; Scioli-Salter et al., 2016) and risks for developing CVD (Edmondson, Kronish, Shaffer, Falzon, & Burg, 2013; Edmondson & von Kanel, 2017; Koenen et al., 2017; Pacella, Hruska, & Delahanty, 2013). There is also evidence that PTSD symptoms mediate the association between childhood maltreatment and physical health problems (Brennstuhl et al., 2015; Pacella et al., 2013), but this relationship requires further consideration in light of the recently published 11th version of the International Classification of Diseases (ICD-11) (World Health Organization, 2018).

In contrast to ICD-10 (World Health Organization, 2004) and DSM-IV/DSM-5 (American Psychiatric Association, 1994, 2013), PTSD is no longer comprised of both fear (e.g., startle response, flashbacks) and dysphoria (e.g., diminished interests in activities, sleep difficulties, concentration problems) symptoms in ICD-11. Instead, PTSD is described in more narrow terms and as a purely fear-based disorder, with six symptoms that are directly related to the traumatic event. The dysphoria symptoms, which are common to many other mental disorders, were removed in an effort to increase specificity of the diagnosis (Friedman, 2014). Thus, it remains to be seen if PTSD symptoms - as reconceptualized by ICD-11 – continue to mediate the association between childhood trauma and physical health problems in adulthood as

fewer but more severe cases PTSD will likely be identified using ICD-11 compared with ICD-10 or DSM-5 (Barbano et al., 2019).

Furthermore, ICD-11 introduced Complex PTSD (CPTSD) into the diagnostic nomenclature for the first time. This disorder includes the core PTSD symptoms along with an additional three symptom clusters reflective of dysphoria, i.e. problems with emotion regulation, self-concept, and interpersonal relationships. These symptoms are collectively termed 'Disturbance in Self-Organization' (DSO), which are not necessarily linked to trauma-specific triggers but, rather, more pervasive and long-term experiences of trauma. Existing evidence indicates that CPTSD is more likely to result following exposure to childhood trauma than PTSD (Cloitre et al., 2019); that it is a more impairing disorder than PTSD (Karatzias et al., 2017); and is more strongly correlated with other mental health problems such as depression, generalized anxiety, dissociation (Hyland, Shevlin, Fyvie, & Karatzias, 2018), and comorbid borderline personality and somatoform disorders (van Dijke et al., 2012). To date, no study has assessed if DSO symptoms also mediate the association between childhood trauma and physical health problems. The separation of PTSD and DSO symptoms in the diagnostic nomenclature offers the opportunity to test (1) if specific fear-based symptoms (i.e., PTSD symptoms) and more general, dysphoria-related symptoms (i.e., DSO symptoms) are differentially associated with physical health problems, and (2) if one, both, or neither of these symptoms mediate the association between childhood trauma and adult physical health problems.

In this study, we examined if PTSD and DSO symptoms mediated, partially or fully, the associations between childhood trauma and somatic problems and CVD load. We tested if PTSD and DSO symptoms mediated the association between childhood trauma and somatic problems in a general population sample of adults from the Republic of Ireland, and if PTSD and DSO

symptoms mediated the association between childhood trauma and CVD load in a trauma-exposed general population sample of adults from the United Kingdom (UK). We did not aim to establish causal pathways given the cross-sectional nature of our datasets but, rather, aimed to assess the magnitude of differences in physical health outcomes due to childhood trauma that would remain when an intermediate psychological risk factor (i.e. posttraumatic stress) varies. We separated childhood trauma into two categories: (a) physical or sexual abuse, representing physical forms of maltreatment that cause pain and direct bodily harm, and (b) emotional abuse or neglect, representing psychological forms of maltreatment that cause emotional pain and do not involve direct bodily harm (Afifi et al., 2016; Briere & Elliott, 2003). Although both types of maltreatment often co-occur, they can happen independent from one another (Debowska, Willmott, Boduszek, & Jones, 2017; Haahr-Pedersen et al., Accepted) and far fewer studies have assessed specific long-term effects of emotional abuse and neglect, relative to physical and sexual abuse, on physical health (Hovens et al., 2010).

Methods

Participants and procedures

This cross-sectional descriptive study was based on data collected from general population surveys of adults in Ireland (N = 1,020) and the UK (N = 1,051). These data were collected in 2019 and 2017, respectively, using very similar recruitment methods. In both cases, an Irish-based online research panel survey company that maintains nationally representative panels of adults in both countries (Qualtrics) was employed to recruit participants. The participants were members of nationally representative research panels in Ireland and the UK. Participants in both surveys were eligible for inclusion if they were aged 18 years or older at the time of survey and were capable of completing the survey in English. In the Irish study,

participants were selected to be representative of the general adult population in terms of sex, age, and geographical distribution. No further inclusion or exclusion criteria were used. In the UK study, two additional inclusion criteria were applied: Participants were selected if they were born in the UK, and had experienced at least one traumatic life event, defined as screening positive for any event from the Life Events Checklist for DSM-5 (Weathers et al., 2013). Basic sociodemographic information for two samples is presented in Table 1. Ethical approval for the collection of both datasets was obtained from the university ethics committee by the final author. No inducements were used to recruit the participants but remuneration was offered on a general basis for participation in the research surveys.

Table 1 here

Measures

Predictor variables

Childhood trauma: In the Irish and UK surveys, participants completed the Adverse Childhood Experiences Questionnaire (Felitti et al., 1998). This questionnaire includes ten binary coded items (0 = No, 1 = Yes) that measure different types of traumas and adversities that occur in the first 18 years of life. We selected four of these items to measure childhood physical or sexual abuse and childhood emotional abuse or neglect. Physical/sexual abuse was indicated by a positive response to either ACE2 (*‘Did a parent or other adult in the household often push, grab, slap, or throw something at you? Or, ever hit you so hard that you had marks or were injured?’*) or ACE3 (*‘Did an adult or person at least 5 years older than you ever touch or fondle you or have you touch their body in a sexual way? Or, try to or actually have oral, anal, or vaginal sex with you?’*). Emotional neglect/abuse was indicated by a positive response to either ACE1 (*‘Did*

a parent or other adult in the household often swear at you, insult you, put you down, or humiliate you? Or, act in a way that made you afraid that you might be physically hurt?') or ACE4 ('Did you often feel that no one in your family loved you or thought you were important or special? Or, your family didn't look out for each other, feel close to each other, or support each other?').

Mediator variables

PTSD and DSO symptoms: In the Irish and UK surveys, participants completed the International Trauma Questionnaire (ITQ: (Cloitre, Shevlin, et al., 2018). This questionnaire is a self-report measure of all diagnostic requirements for ICD-11 PTSD and CPTSD. The ITQ first screens for the respondents' worst traumatic event, and how long ago this event occurred. Respondents are then instructed to answer all subsequent questions in relation to this event. There are six questions measuring each PTSD symptom (Irish sample, $\alpha = .90$; UK sample, $\alpha = .91$) and six questions measuring each DSO symptom (Irish sample, $\alpha = .93$; UK sample, $\alpha = .92$). PTSD symptoms are answered in terms of how much the respondent has been bothered by that symptom in the past month, and DSO symptoms are answered in terms of how the respondent typically feels, thinks about oneself, and relates to others. All items are answered on a five-point Likert scale ranging from 0 (Not at all) to 4 (Extremely) with higher scores reflecting higher levels of PTSD and DSO symptoms. Multiple factor analytic studies indicate that the ITQ measures two correlated second-order factors: 'PTSD' and 'DSO' symptoms. The 'PTSD' factor captures the covariation between three first-order factors ('Re-experiencing in the here and now', 'Avoidance', and 'Sense of Threat') and the 'DSO' factor explains covariation between another three first-order factors ('Affective Dysregulation', 'Negative Self Concept', and 'Disturbed Relationships') (Brewin et al., 2017; Cloitre, Shevlin, et al., 2018). The reliability and validity of

the ITQ has been demonstrated in multiple general population samples (Ben-Ezra et al., 2018; Cloitre, Hyland, et al., 2018).

Criterion variables

Somatic problems: In the Irish study, participants completed the 10-item somatization subscale of the Trauma Symptom Inventory 2 (TSI-2: (Briere, 2011). This subscale measures ten different types of somatic problems (aches and pains, lower back pains, muscle spasms, chest pain, dizziness, nausea, indigestion, ringing in ears, difficulty swallowing, and difficulty maintaining balance). Respondents were asked to indicate how often they experienced each type of somatic problem in the last six months on a four-point Likert scale from 0 (Never) to 3 (Often). Higher scores reflect higher levels of somatic problems. The internal reliability of this measure in the Irish sample was satisfactory ($\alpha = .87$).

CVD load: In the UK study, participants completed the Charlson Comorbidity Index (CCI) (Charlson, Pompei, Ales, & MacKenzie, 1987; Quan et al., 2005), a commonly used self-report measure of whether respondents have ever been diagnosed (0 = No, 1 = Yes) with 19 different chronic illnesses that are categorized in line with the ICD-10 diagnostic codes (Sundararajan et al., 2004). The CCI includes five diseases reflecting CVDs: hypertension, cerebrovascular disease, heart disease (i.e., cardiovascular disease, myocardial infarction, congestive heart failure, chronic heart disease, or dilated cardiomyopathy), peripheral vascular disease, and stroke. Affirmative responses to each of these diseases are summed to recreate a score representative of overall CVD load. The psychometric properties of the CCI, including its predictive validity for mortality outcomes, have been well-documented (de Groot, Beckerman, Lankhorst, & Bouter, 2003; Toson, Harvey, & Close, 2015).

Covariates

We were able to include four sociodemographic variables as covariates of somatic problems and CVD load in all analyses as these variables were answered in the Irish and UK studies. These variables were sex (0 = male, 1 = female), age, employment status (0 = employed, retired, student, or homemaking, 1 = unemployed and seeking work), and educational status (0 = did not attend university, 1 = attended university). These covariates were included in the models based on existing evidence of their association with somatic problems or CVD in trauma samples (Batten, Aslan, Maciejewski, & Mazure, 2004; S. McCall-Hosenfeld, Winter, Heeren, & Liebschutz, 2014).

Data analysis

Structural equation modelling (SEM) was used to test if PTSD and DSO symptoms mediated – fully, partially, or not at all – the associations between the two types of childhood trauma (i.e., physical or sexual abuse and emotional abuse or neglect) and somatic problems (based on the Irish sample) and CVD load (based on the UK sample). Three nested models were tested, and these are illustrated in Figures 1 and 2.

Insert figure 1 here

Insert figure 2 here

Model 1 was a ‘direct effects only model’ where PTSD and DSO symptoms had no mediating effect on the associations between both types of childhood trauma and physical health problems. As per Figures 1 and 2, the a and b paths were fixed to zero and the c’ paths were freely estimated.

Model 2 was an ‘indirect effects only model’ where PTSD and DSO symptoms fully mediated the associations between both types of childhood trauma and physical health problems. In this model, the a and b paths were freely estimated and the c’ paths were fixed to zero.

Model 3 was a ‘direct and indirect effects model’ where the two types of childhood trauma were directly associated with physical health problems and were also indirectly associated with physical health problems via PTSD and DSO symptoms. This model reflects a partial mediation effect for PTSD and DSO symptoms between childhood trauma and physical health problems. Thus, the a, b, and c’ paths were freely estimated.

In both models, the predictor variables of childhood physical and sexual abuse, and childhood emotional abuse and neglect, were treated as observed variables. The mediator variables of PTSD and DSO symptoms were treated as latent variables; consistent with the ITQ’s latent structure, PTSD was measured via the total subscale scores of re-experiencing, avoidance, and sense of threat, and DSO was measured via the total subscale scores of affective dysregulation, negative self-concept, and disturbed relationships. The criterion variables of ‘Somatic Problems’ and ‘CVD Load’ were entered into the model as latent variables. Somatic Problems was measured via the ten items of the somatic subscale of the TSI-2, and CVD Load was measured via the five items chosen from the CCI. The covariates were treated as observed variables and were regressed onto the criterion and mediator variables in both models.

Constructing latent variables for the mediator and criterion variables had the advantage of (a) controlling for measurement error and thus producing more reliable direct and indirect parameter estimates, and (b) ensuring that both models were tested using the same model estimator and, therefore, that all parameters were estimated as linear regression coefficients. This is especially important when estimating and interpreting indirect effects.

All models were tested using Mplus version 8.2 (Muthén & Muthén, 2017), and estimated using the weighted least squares mean- and variance-adjusted estimator (WLSMV). This estimator is appropriate for use with binary and ordinal categorical indicators, and has been shown to produce "...accurate test statistics, parameter estimates and standard errors under both normal and nonnormal latent response distributions across all sample sizes and model complexities" (Flora & Curran, 2004). Standard guidelines were followed to determine the adequacy of model fit (Hu & Bentler, 1999). Acceptable fit is indicated by Comparative Fit Index (CFI) and Tucker-Lewis Index (TLI) values $> .90$, Root Mean Square Error of Approximation (RMSEA) and Standardized Root Mean Square Residual (SRMR) values $< .08$, and a non-significant chi-square (χ^2) result. However, the χ^2 test produces Type 1 errors in large samples and should not be used to reject otherwise good fitting models (Tanaka, 1987).

To compare the three nested models, we examined changes in the RMSEA (Δ RMSEA) as this fit index includes penalties for increasing model complexity. Δ RMSEA values $> .015$ indicate a significant improvement in model fit (Chen, Curran, Bollen, Kirby, & Paxton, 2008). To test the significance of indirect effects in Models 2 and 3, we used tests of joint significance (Kenny, Kashy, & Bolger, 1998; Mallinckrodt, Abraham, Wei, & Russell, 2006). Simulation studies have shown that this method may be superior to alternative methods such as the bias-corrected bootstrapping method as it produces fewer Type 1 errors (Fritz, Taylor, & Mackinnon, 2012; Leth-Steensen & Gallitto, 2016; Taylor, MacKinnon, & Tein, 2007; Thoemmes, Mackinnon, & Reiser, 2010).

Results

Descriptive statistics

In the Irish sample, 35.9% ($n = 366$) reported a history of childhood physical or sexual abuse and 44.3% ($n = 452$) reported a history of childhood emotional abuse or neglect; 29.0% ($n = 296$) reported a history of both. Their mean PTSD symptom score was 6.16 ($Mdn = 5.00$, $SD = 5.75$, range 0-24), and their mean DSO symptom score was 7.31 ($Mdn = 6.00$, $SD = 6.21$, range 0-24). Their somatic problems scores ranged from 0-29, with a mean of 9.93 ($Mdn = 9.00$, $SD = 6.52$).

In the UK sample, 40.8% ($n = 429$) and 47.0% ($n = 494$) reported a history of childhood physical or sexual abuse and childhood emotional abuse or neglect, respectively; 32.9% ($n = 326$) reported a history of both. Their mean PTSD symptom score was 6.55 ($Mdn = 4.00$, $SD = 6.59$, range 0-24), and their mean DSO symptoms score was 8.12 ($Mdn = 6.00$, $SD = 6.99$, range 0-24). 9.0% ($n = 95$) of participants reported at least one indicator of CVD, with a mean CVD load of 0.11 ($Mdn = 0.00$, $SD = 0.37$, range 0-3).

SEM model of Somatic Problems

The fit statistics for the three models of somatic problems in the Irish sample are reported in Table 2. The direct effects only model (Model 1) was a poor fit of data. The fully indirect model (Model 2) was significantly better than the direct effects only model ($\Delta RMSEA = -.060$) and the CFI, TLI, RMSEA, and SRMR results indicated acceptable model fit. The direct and indirect effects model (Model 3) had very similar fit to Model 2, and the RMSEA value was .003 higher than Model 2. Thus, the inclusion of the direct effects from childhood trauma to Somatic Problems was not supported. Model 2 was deemed the best fitting model as the additional parameters added in Model 3 did not lead to a significant improvement in fit.

Insert table 2 here

As detailed in Table 3, Model 2 explained 25.2% of variance in PTSD symptoms, 28.2% of variance in DSO symptoms, and 39.8% of variance in somatic problems ($ps < .001$). With the effect of the covariates removed, the model explained 19.0%, 20.7%, and 37.6% of variance in PTSD, DSO, and somatic problems, respectively ($ps < .001$). All indicators of the PTSD, DSO, and Somatic Problems latent variables loaded onto their respective factors positively, significantly ($ps < .001$), and robustly (all factor loadings $> .50$). The direct and indirect regression coefficients are also reported in Table 3.

Insert table 3 here

Childhood physical or sexual abuse and childhood emotional abuse or neglect were positively and significantly associated with PTSD and DSO symptoms, and the effects were stronger for emotional abuse and neglect. Additionally, PTSD and DSO symptoms were significantly and positively associated with Somatic Problems. Childhood physical and sexual abuse was indirectly associated with Somatic Problems via PTSD ($\beta = .04$, $SE = .01$, $p = .003$) and DSO ($\beta = .04$, $SE = .02$, $p = .007$) symptoms. Likewise, childhood emotional abuse and neglect was indirectly associated with Somatic Problems via PTSD ($\beta = .10$, $SE = .02$, $p < .001$) and DSO ($\beta = .14$, $SE = .02$, $p < .001$) symptoms.

Regarding the covariates in the model, higher PTSD symptom scores were associated with being female ($\beta = .09$, $p = .003$) and younger age ($\beta = -.19$, $p < .001$); higher DSO symptoms were also associated with being female ($\beta = .09$, $p = .002$) and younger age ($\beta = -.21$, $p < .001$); and higher Somatic Problems scores were associated with being female ($\beta = .08$, $p = .006$), older age ($\beta = .16$, $p < .001$), and lower educational attainment ($\beta = .06$, $p = .042$).

SEM model of CVD load

The fit statistics for the three SEM models of CVD Load in the UK sample are also reported in Table 2. Similar to the models of Somatic Problems, the direct effects only model (Model 1) was a poor representation of the sample data; the fully indirect model (Model 2) was statistically superior to the direct effects only model ($\Delta\text{RMSEA} = -.048$) and provided acceptable fit to the data based on the CFI, TLI, and RMSEA results (however, the SRMR indicated poor model fit). The direct and indirect effects model (Model 3) yielded similar fit statistics to Model 2, therefore, the inclusion of the direct effects from childhood trauma to CVD Load were not supported. The fully indirect model (Model 2) was deemed to the best representation of the UK sample data on the grounds of parsimony and overall model fit.

As detailed in Table 4, Model 2 explained 24.0% of variance in PTSD symptoms, 32.2% of variance in DSO symptoms, and 28.3% of variance in CVD Load ($ps < .001$). With the effect of the covariates removed, the model explained 14.4%, 18.2%, and 13.3% of variance in PTSD, DSO, and CVD Load, respectively ($ps < .001$). All indicators of the PTSD, DSO, and CVD Load latent variables loaded onto their respective factor positively, significantly ($ps < .001$) and robustly (all factor loadings $> .50$). The direct and indirect associations are also reported in Table 4.

Insert table 4 here

Childhood physical or sexual abuse and childhood emotional abuse or neglect were significantly and positively associated with PTSD and DSO symptoms, and the effects were again stronger for emotional abuse and neglect. PTSD symptoms, but not DSO symptoms, were significantly and positively associated with CVD Load. Childhood physical and sexual abuse was indirectly associated with CVD Load via PTSD symptoms ($\beta = .05$, $SE = .02$, $p = .001$), and

childhood emotional abuse and neglect was also indirectly associated with CVD Load via PTSD symptoms ($\beta = .06$, $SE = .02$, $p < .001$).

Regarding the covariates in the model, higher PTSD symptom scores were associated with being female ($\beta = .08$, $p = .019$) and younger age ($\beta = -.26$, $p < .001$); higher DSO symptoms were associated with younger age ($\beta = -.36$, $p < .001$) and being unemployed ($\beta = .09$, $p = .001$); and higher CVD Load was associated with older age ($\beta = .54$, $p < .001$).

Discussion

In this study, we used data from two general population surveys to conduct the first assessment of whether ICD-11 CPTSD symptoms mediated the associations between physical and psychological forms of childhood trauma and physical health problems during adulthood. Our results showed that the more narrowly defined set of PTSD symptoms in ICD-11 were positively associated with physical health problems – both subjective (somatic problems) and objective (diagnosis of a CVD related disease) – and mediated the association between different forms of childhood trauma and physical health problems. The decision in ICD-11 to narrow the focus of PTSD symptoms to fear-based responses to the traumatic events appears not to have affected previously established relationships between PTSD and physical health problems (see Bisson (2019)).

Notably, our findings corroborate with previous research suggesting somatic problems are indirectly associated with childhood maltreatment through PTSD (Rebecca Campbell, Megan R Greeson, Deborah Bybee, & Sheela Raja, 2008; Abigail Powers et al., 2014), and further showed that the DSO symptoms that distinguish CPTSD from PTSD in ICD-11 were positively correlated with these subjective physical health complaints. Together, these results suggest that,

in the context of childhood trauma, subjective measures of adult physical health are influenced by stress symptoms that directly relate to trauma (i.e. PTSD factors), as well as psychological symptoms that culminated as a result of sustained, significant stressors in childhood (i.e. DSO factors). In contrast, DSO symptoms did associate with objective measures of physical disease in the form of CVD load. One possible explanation for why PTSD symptoms, but not DSO symptoms, were related to CVD load is that PTSD symptoms - especially those related to repeated activation of the autonomic nervous system such as flashbacks, hypervigilance, and hyperarousal - result in intermittently exaggerated cardiovascular demands which, in the long-run, can induce chronic cardiovascular alterations in the form of increased resting heart rate and lower heart rate variability; both of which are associated with poorer heart health (Coughlin, 2011; Edmondson & von Känel, 2017). DSO symptoms, which involve a persistent sense of low self-worth, affect dysregulation, and disturbances in interpersonal relationships, may not necessarily induce the same types or the same extent of physiological responses as the PTSD symptoms that subsequently increase cardiovascular morbidity and mortality.

Clearly, far more research on the association between DSO symptoms and CVD is required, but our findings provide a basis to understand how the different sets of posttraumatic stress symptoms relate to cardiovascular health in the context of childhood trauma. These findings have implications for researchers who use the DSM-5 model of PTSD (American Psychological Association, 2013) because the DSM-5 takes a broad-based approach to describing posttraumatic responses and includes fear-based and dysphoric symptoms together within the same diagnosis. It is very possible – based on current results – that estimates of the association between DSM-5 PTSD and CVD will be underestimated given the inclusion of a

large number of dysphoria-based symptoms. Direct comparisons between the ICD-11 and DSM-5 models of PTSD and CVD are needed to answer this question.

In both samples, we found that the direct effects of emotional abuse or neglect on PTSD and DSO symptoms, and their indirect effects on physical health problems, were stronger than those for physical or sexual abuse. These results are consistent with some existing evidence demonstrating that emotional forms of trauma are more strongly associated with mental health problems, such as depression and psychosis, than physical or sexual forms of trauma (Grossman, Sorsoli, & Kia-Keating, 2006; Varese et al., 2012). In turn, poorer mental health as a result of psychological trauma are associated with increased risks for physical health problems; a well-established pathway is through the upregulation of the inflammatory response system (Kendall-Tackett, 2009). To date, however, emotional trauma that does not include a physical threat is not necessarily included as a criterion A (potentially traumatic) event in either diagnostic manual. Despite this fact, our results showed that these kinds of event are significantly linked with poorer physical health in adulthood via PTSD and DSO symptoms, and perhaps more so than physical forms of childhood maltreatment. Although emotional and physical forms of childhood maltreatment tend to co-occur, emotional trauma is more common during childhood and these different forms of maltreatment can happen independent from one another (Debowska et al., 2017; Haahr-Pedersen et al., Accepted). Therefore, further investigations to clarify the disease burden and healthcare needs that are uniquely associated with emotional abuse and emotional neglect in childhood, and whether and to what extent these forms of trauma should be included as a potentially traumatic event for diagnosis are warranted.

Several study limitations require consideration. First, we used different samples to investigate the two physical health related criterion variables and this precludes identifying

unique effects for somatic problems and CVD load. It is possible that some of the somatic problems identified in the Irish sample were attributable to unmeasured CVD, or to some other unmeasured physical disease. Future studies that simultaneously model somatic problems and CVD load will be important to determine if these findings replicate. Second, we did not account for non-interpersonal forms of trauma during childhood (e.g., life-threatening car accidents), or trauma exposure during adulthood, both of which may have had an influence the criterion variables examined in this study. Third, we only had a limited number covariates available across the two samples and could not, therefore, account for other potentially important health-related sociodemographic risk factors (e.g., ethnicity; smoking; sedentary lifestyle; and other health problems such as mental disorders, metabolic syndrome, or obesity). We were also unable to account for other potentially relevant psychological and social factors that may influence physical health in the context of childhood trauma; these include coping strategies, internal resources, and social support. Further, the samples, although nationally representative of the general adult population in Ireland and the UK, may over-represent well-resourced or well-educated persons due to the use of an online survey platform. Finally, the cross-sectional design of the study precludes interpretations of causality in the longitudinal health impact of childhood maltreatment through PTSD and DSO symptoms; cross-sectional mediation models can be prone to generating biased estimations and is further limited by the assumptions being made about the temporal relation between variables. Retrospective self-reporting bias may also influence tendencies to report past trauma and current CPTSD symptoms or health problems.

Notwithstanding these limitations, this study provides the first piece of empirical evidence that ICD-11 CPTSD symptoms may influence the association between childhood trauma and physical health problems. Moreover, these results are important as they suggest that

PTSD and DSO symptoms may play different roles in linking different forms of childhood trauma to different types of physical health problems, with PTSD symptoms being especially pertinent to objectively diagnosed CVD. Clinical interventions that treat CPTSD may, therefore, have the additional benefit of improving different physical health related complaints. The importance of childhood trauma and stress-related psychopathology are only beginning to be recognized as risk-factors in cardiovascular medicine (Koenen et al., 2017). Our findings add to a growing literature that supports routine screening for early-life trauma and continuing efforts to pinpoint effective interventions that ameliorate the negative health consequences of trauma exposure in the primary care and specialist healthcare settings (Dube, 2018; Finkelhor, 2018; Purewal et al., 2016). Additional research using longitudinal designs is needed to establish the causal pathways from childhood trauma to different types of adult physical health problems, to ascertain the mediating role of PTSD and DSO symptoms in these relationships, and to further investigate and differentiate the unique contribution of childhood emotional trauma to adult health.

References

- Afifi, T. O., MacMillan, H. L., Boyle, M., Cheung, K., Taillieu, T., Turner, S., & Sareen, J. (2016). Child abuse and physical health in adulthood. *Health Rep*, 27(3), 10-18.
- American Psychiatric Association. (1994). *Diagnostic and statistical manual of mental disorders (4th ed.)*. Washington, DC: Author.
- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders (5th ed.)*. Washington, DC: Author.
- American Psychological Association. (2013). Diagnostic and Statistical Manual of Mental Disorders. In (5th Edition ed.). Washington DC: Author.
- Barbano, A. C., van der Mei, W. F., Bryant, R. A., Delahanty, D. L., deRoos-Cassini, T. A., Matsuoka, Y. J., . . . Schnyder, U. (2019). Clinical implications of the proposed ICD-11 PTSD diagnostic criteria. *Psychological Medicine*, 49(3), 483-490.
- Basu, A., McLaughlin, K. A., Misra, S., & Koenen, K. C. (2017). Childhood Maltreatment and Health Impact: The Examples of Cardiovascular Disease and Type 2 Diabetes Mellitus in Adults. *Clin Psychol (New York)*, 24(2), 125-139. doi:10.1111/cpsp.12191
- Batten, S. V., Aslan, M., Maciejewski, P. K., & Mazure, C. M. (2004). Childhood maltreatment as a risk factor for adult cardiovascular disease and depression. *Journal of Clinical Psychiatry*, 65(2), 249-254.
- Ben-Ezra, M., Karatzias, T., Hyland, P., Brewin, C. R., Cloitre, M., Bisson, J. I., . . . Shevlin, M. (2018). Posttraumatic stress disorder (PTSD) and complex PTSD (CPTSD) as per ICD-11 proposals: A population study in Israel. *Depress Anxiety*, 35(3), 264-274. doi:10.1002/da.22723
- Bisson, J. I. (2019). Stress related disorders and physical health. *Bmj*, 367, l6036. doi:10.1136/bmj.l6036
- Brennstuhl, M. J., Tarquinio, C., & Montel, S. (2015). Chronic Pain and PTSD: Evolving Views on Their Comorbidity. *Perspect Psychiatr Care*, 51(4), 295-304. doi:10.1111/ppc.12093

- Brewin, C. R., Cloitre, M., Hyland, P., Shevlin, M., Maercker, A., Bryant, R. A., . . . Reed, G. M. (2017). A review of current evidence regarding the ICD-11 proposals for diagnosing PTSD and complex PTSD. *Clinical Psychology Review*, 58, 1-15. doi:10.1016/j.cpr.2017.09.001
- Briere, J. (2011). *Trauma Symptom Inventory–2 (TSI–2)*. Odessa, FL: Psychological Assessment Resources.
- Briere, J., & Elliott, D. M. (2003). Prevalence and psychological sequelae of self-reported childhood physical and sexual abuse in a general population sample of men and women. *Child Abuse Negl*, 27(10), 1205-1222. doi:10.1016/j.chiabu.2003.09.008
- Campbell, R., Greeson, M. R., Bybee, D., & Raja, S. (2008). The co-occurrence of childhood sexual abuse, adult sexual assault, intimate partner violence, and sexual harassment: a mediational model of posttraumatic stress disorder and physical health outcomes. *J Consult Clin Psychol*, 76(2), 194-207. doi:10.1037/0022-006x.76.2.194
- Campbell, R., Greeson, M. R., Bybee, D., & Raja, S. (2008). The co-occurrence of childhood sexual abuse, adult sexual assault, intimate partner violence, and sexual harassment: a mediational model of posttraumatic stress disorder and physical health outcomes. *Journal of consulting and clinical psychology*, 76(2), 194.
- Charlson, M. E., Pompei, P., Ales, K. L., & MacKenzie, C. R. (1987). A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. *J Chronic Dis*, 40(5), 373-383. doi:10.1016/0021-9681(87)90171-8
- Chen, F., Curran, P. J., Bollen, K. A., Kirby, J., & Paxton, P. (2008). An Empirical Evaluation of the Use of Fixed Cutoff Points in RMSEA Test Statistic in Structural Equation Models. *Sociol Methods Res*, 36(4), 462-494. doi:10.1177/0049124108314720
- Cloitre, M., Hyland, P., Bisson, J. I., Brewin, C. R., Roberts, N. P., Karatzias, T., & Shevlin, M. (2018). ICD-11 PTSD and Complex PTSD in the United States: A population-based study. *J Trauma Stress*.

- Cloitre, M., Hyland, P., Bisson, J. I., Brewin, C. R., Roberts, N. P., Karatzias, T., & Shevlin, M. (2019). ICD-11 Posttraumatic Stress Disorder and Complex Posttraumatic Stress Disorder in the United States: A Population-Based Study. *J Trauma Stress*, 32(6), 833-842. doi:10.1002/jts.22454
- Cloitre, M., Shevlin, M., Brewin, C. R., Bisson, J. I., Roberts, N. P., Maercker, A., . . . Hyland, P. (2018). The International Trauma Questionnaire: development of a self-report measure of ICD-11 PTSD and complex PTSD. *Acta Psychiatr Scand*, 138(6), 536-546. doi:10.1111/acps.12956
- Coelho, R., Viola, T. W., Walss-Bass, C., Brietzke, E., & Grassi-Oliveira, R. (2014). Childhood maltreatment and inflammatory markers: a systematic review. *Acta Psychiatr Scand*, 129(3), 180-192. doi:10.1111/acps.12217
- Coughlin, S. S. (2011). Post-traumatic Stress Disorder and Cardiovascular Disease. *The open cardiovascular medicine journal*, 5, 164-170. doi:10.2174/1874192401105010164
- Davis, D. A., Luecken, L. J., & Zautra, A. J. (2005). Are reports of childhood abuse related to the experience of chronic pain in adulthood? A meta-analytic review of the literature. *Clin J Pain*, 21(5), 398-405. doi:10.1097/01.ajp.0000149795.08746.31
- de Groot, V., Beckerman, H., Lankhorst, G. J., & Bouter, L. M. (2003). How to measure comorbidity. a critical review of available methods. *J Clin Epidemiol*, 56(3), 221-229. doi:10.1016/s0895-4356(02)00585-1
- Debowska, A., Willmott, D., Boduszek, D., & Jones, A. D. (2017). What do we know about child abuse and neglect patterns of co-occurrence? A systematic review of profiling studies and recommendations for future research. *Child Abuse Negl*, 70, 100-111. doi:10.1016/j.chiabu.2017.06.014
- Dube, S. R. (2018). Continuing conversations about adverse childhood experiences (ACEs) screening: A public health perspective. *Child Abuse Negl*, 85, 180-184. doi:10.1016/j.chiabu.2018.03.007
- Edmondson, D., Kronish, I. M., Shaffer, J. A., Falzon, L., & Burg, M. M. (2013). Posttraumatic stress disorder and risk for coronary heart disease: a meta-analytic review. *Am Heart J*, 166(5), 806-814. doi:10.1016/j.ahj.2013.07.031

- Edmondson, D., & von Kanel, R. (2017). Post-traumatic stress disorder and cardiovascular disease. *Lancet Psychiatry*, 4(4), 320-329. doi:10.1016/s2215-0366(16)30377-7
- Edmondson, D., & von Känel, R. (2017). Post-traumatic stress disorder and cardiovascular disease. *Lancet Psychiatry*, 4(4), 320-329. doi:10.1016/S2215-0366(16)30377-7
- Felitti, V. J., Anda, R. F., Nordenberg, D., Williamson, D. F., Spitz, A. M., Edwards, V., . . . Marks, J. S. (1998). 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*, 14(4), 245-258.
- Finkelhor, D. (2018). Screening for adverse childhood experiences (ACEs): Cautions and suggestions. *Child Abuse and Neglect*, 85, 174-179. doi:10.1016/j.chiabu.2017.07.016
- Flora, D. B., & Curran, P. J. (2004). An empirical evaluation of alternative methods of estimation for confirmatory factor analysis with ordinal data. *Psychol Methods*, 9(4), 466-491. doi:10.1037/1082-989x.9.4.466
- Friedman, M. (2014). Literature on DSM-5 and ICD-11. *PTSD Research Quarterly*, 25(2), 1-10.
- Fritz, M. S., Taylor, A. B., & Mackinnon, D. P. (2012). Explanation of Two Anomalous Results in Statistical Mediation Analysis. *Multivariate Behav Res*, 47(1), 61-87. doi:10.1080/00273171.2012.640596
- Grossman, F. K., Sorsoli, L., & Kia-Keating, M. (2006). A gale force wind: meaning making by male survivors of childhood sexual abuse. *Am J Orthopsychiatry*, 76(4), 434-443. doi:10.1037/0002-9432.76.4.434
- Haahr-Pedersen, I., Perera, C., Hyland, P., Vallieres, F., Murphy, D., Hansen, M., . . . Cloitre, M. (Accepted). Females have more complex patterns of childhood adversity: Implications for mental, social, and emotional outcomes in adulthood. *European Journal of Psychotraumatology*.
- Haller, H., Cramer, H., Lauche, R., & Dobos, G. (2015). Somatoform disorders and medically unexplained symptoms in primary care. *Deutsches Arzteblatt international*, 112(16), 279-287. doi:10.3238/arztebl.2015.0279

- Hovens, J. G., Wiersma, J. E., Giltay, E. J., van Oppen, P., Spinhoven, P., Penninx, B. W., & Zitman, F. G. (2010). Childhood life events and childhood trauma in adult patients with depressive, anxiety and comorbid disorders vs. controls. *Acta Psychiatr Scand*, 122(1), 66-74. doi:10.1111/j.1600-0447.2009.01491.x
- Hu, L. t., & 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., . . . Dunne, M. P. (2017). The effect of multiple adverse childhood experiences on health: a systematic review and meta-analysis. *Lancet Public Health*, 2(8), e356-e366. doi:10.1016/s2468-2667(17)30118-4
- Hyland, P., Shevlin, M., Fyvie, C., & Karatzias, T. (2018). Posttraumatic Stress Disorder and Complex Posttraumatic Stress Disorder in DSM-5 and ICD-11: Clinical and Behavioral Correlates. *J Trauma Stress*, 31(2), 174-180. doi:10.1002/jts.22272
- Kalmakis, K. A., & Chandler, G. E. (2015). Health consequences of adverse childhood experiences: a systematic review. *J Am Assoc Nurse Pract*, 27(8), 457-465. doi:10.1002/2327-6924.12215
- Karatzias, T., Shevlin, M., Fyvie, C., Hyland, P., Efthymiadou, E., Wilson, D., . . . Cloitre, M. (2017). Evidence of distinct profiles of Posttraumatic Stress Disorder (PTSD) and Complex Posttraumatic Stress Disorder (CPTSD) based on the new ICD-11 Trauma Questionnaire (ICD-TQ). *J Affect Disord*, 207, 181-187. doi:10.1016/j.jad.2016.09.032
- Kendall-Tackett, K. (2009). Psychological trauma and physical health: A psychoneuroimmunology approach to etiology of negative health effects and possible interventions. *Psychological Trauma: theory, research, practice, and policy*, 1(1), 35.
- Kenny, D. A., Kashy, D. A., & Bolger, N. (1998). Data analysis in social psychology. In *The handbook of social psychology*, Vols. 1-2, 4th ed. (pp. 233-265). New York, NY, US: McGraw-Hill.
- Kirmayer, L. J., Groleau, D., Looper, K. J., & Dao, M. D. (2004). Explaining medically unexplained symptoms. *Can J Psychiatry*, 49(10), 663-672. doi:10.1177/070674370404901003

- Koenen, K. C., Sumner, J. A., Gilsanz, P., Glymour, M. M., Ratanatharathorn, A., Rimm, E. B., . . . Kubzansky, L. D. (2017). Post-traumatic stress disorder and cardiometabolic disease: improving causal inference to inform practice. *Psychol Med*, 47(2), 209-225.
doi:10.1017/s0033291716002294
- Leth-Steensen, C., & Gallitto, E. (2016). Testing Mediation in Structural Equation Modeling: The Effectiveness of the Test of Joint Significance. *Educ Psychol Meas*, 76(2), 339-351.
doi:10.1177/0013164415593777
- Mallinckrodt, B., Abraham, W. T., Wei, M., & Russell, D. W. (Producer). (2006). Advances in testing the statistical significance of mediation effects. [doi:10.1037/0022-0167.53.3.372]
- Mayou, R., & Farmer, A. (2002). ABC of psychological medicine: Functional somatic symptoms and syndromes. *Bmj*, 325(7358), 265-268. doi:10.1136/bmj.325.7358.265
- McKernan, L. C., Johnson, B. N., Crofford, L. J., Lumley, M. A., Bruehl, S., & Cheavens, J. S. (2019). Posttraumatic Stress Symptoms Mediate the Effects of Trauma Exposure on Clinical Indicators of Central Sensitization in Patients With Chronic Pain. *Clin J Pain*, 35(5), 385-393.
doi:10.1097/ajp.0000000000000689
- Milligan-Saville, J. S., Paterson, H. M., Harkness, E. L., Marsh, A. M., Dobson, M., Kemp, R. I., . . . Harvey, S. B. (2017). The Amplification of Common Somatic Symptoms by Posttraumatic Stress Disorder in Firefighters. *J Trauma Stress*, 30(2), 142-148. doi:10.1002/jts.22166
- Morina, N., Schnyder, U., Klaghofer, R., Muller, J., & Martin-Soelch, C. (2018). Trauma exposure and the mediating role of posttraumatic stress on somatic symptoms in civilian war victims. *BMC Psychiatry*, 18(1), 92. doi:10.1186/s12888-018-1680-4
- Muthén, L. K., & Muthén, B. O. (2017). *Mplus user's guide*. Los Angeles, CA: Muthén & Muthén.
- Nelson, S., Baldwin, N., & Taylor, J. (2012). Mental health problems and medically unexplained physical symptoms in adult survivors of childhood sexual abuse: an integrative literature review. *J Psychiatr Ment Health Nurs*, 19(3), 211-220. doi:10.1111/j.1365-2850.2011.01772.x

- Pacella, M. L., Hruska, B., & Delahanty, D. L. (2013). The physical health consequences of PTSD and PTSD symptoms: a meta-analytic review. *J Anxiety Disord*, 27(1), 33-46.
doi:10.1016/j.janxdis.2012.08.004
- Powers, A., Fani, N., Pallos, A., Stevens, J., Ressler, K. J., & Bradley, B. (2014). Childhood Abuse and the Experience of Pain in Adulthood: The Mediating Effects of PTSD and Emotion Dysregulation on Pain Levels and Pain-Related Functional Impairment. *Psychosomatics*, 55(5), 491-499.
doi:<https://doi.org/10.1016/j.psych.2013.10.004>
- Powers, A., Fani, N., Pallos, A., Stevens, J., Ressler, K. J., & Bradley, B. (2014). Childhood abuse and the experience of pain in adulthood: the mediating effects of PTSD and emotion dysregulation on pain levels and pain-related functional impairment. *Psychosomatics*, 55(5), 491-499.
doi:10.1016/j.psych.2013.10.004
- Purewal, S. K., Bucci, M., Gutiérrez Wang, L., Koita, K., Silvério Marques, S., Oh, D., & Burke Harris, N. (2016). Screening for adverse childhood experiences (ACEs) in an integrated pediatric care model. *Zero to Three*, 37(1), 10-17.
- Quan, H., Sundararajan, V., Halfon, P., Fong, A., Burnand, B., Luthi, J. C., . . . Ghali, W. A. (2005). Coding algorithms for defining comorbidities in ICD-9-CM and ICD-10 administrative data. *Med Care*, 43(11), 1130-1139. doi:10.1097/01.mlr.0000182534.19832.83
- Raphael, K. G., & Widom, C. S. (2011). Post-traumatic stress disorder moderates the relation between documented childhood victimization and pain 30 years later. *Pain*, 152(1), 163-169.
doi:10.1016/j.pain.2010.10.014
- Rasmussen, L. J. H., Moffitt, T. E., Eugen-Olsen, J., Belsky, D. W., Danese, A., Harrington, H., . . . Caspi, A. (2019). Cumulative childhood risk is associated with a new measure of chronic inflammation in adulthood. *J Child Psychol Psychiatry*, 60(2), 199-208. doi:10.1111/jcpp.12928
- S. McCall-Hosenfeld, J., Winter, M., Heeren, T., & Liebschutz, J. M. (2014). The association of interpersonal trauma with somatic symptom severity in a primary care population with chronic

- pain: Exploring the role of gender and the mental health sequelae of trauma. *Journal of psychosomatic research*, 77(3), 196-204. doi:<https://doi.org/10.1016/j.jpsychores.2014.07.011>
- Scioli-Salter, E. R., Johnides, B. D., Mitchell, K. S., Smith, B. N., Resick, P. A., & Rasmusson, A. M. (2016). Depression and dissociation as predictors of physical health symptoms among female rape survivors with posttraumatic stress disorder. *Psychol Trauma*, 8(5), 585-591. doi:10.1037/tra0000135
- Stoltenborgh, M., Bakermans-Kranenburg, M. J., Alink, L. R. A., & van Ijzendoorn, M. H. (2015). The Prevalence of Child Maltreatment across the Globe: Review of a Series of Meta-Analyses. *Child Abuse Review*, 24(1), 37-50. doi:10.1002/car.2353
- Su, S., Jimenez, M. P., Roberts, C. T. F., & Loucks, E. B. (2015). The role of adverse childhood experiences in cardiovascular disease risk: a review with emphasis on plausible mechanisms. *Current cardiology reports*, 17(10), 88-88. doi:10.1007/s11886-015-0645-1
- Sundararajan, V., Henderson, T., Perry, C., Muggivan, A., Quan, H., & Ghali, W. A. (2004). New ICD-10 version of the Charlson comorbidity index predicted in-hospital mortality. *J Clin Epidemiol*, 57(12), 1288-1294. doi:10.1016/j.jclinepi.2004.03.012
- Tanaka, J. S. (1987). "How Big Is Big Enough?": Sample Size and Goodness of Fit in Structural Equation Models with Latent Variables. *Child Development*, 58(1), 134-146. doi:10.2307/1130296
- Taylor, A. B., MacKinnon, D. P., & Tein, J.-Y. (2007). Tests of the Three-Path Mediated Effect. *Organizational Research Methods*, 11(2), 241-269. doi:10.1177/1094428107300344
- Thoemmes, F., Mackinnon, D. P., & Reiser, M. R. (2010). POWER ANALYSIS FOR COMPLEX MEDIATIONAL DESIGNS USING MONTE CARLO METHODS. *Struct Equ Modeling*, 17(3), 510-534. doi:10.1080/10705511.2010.489379
- Toson, B., Harvey, L. A., & Close, J. C. (2015). The ICD-10 Charlson Comorbidity Index predicted mortality but not resource utilization following hip fracture. *J Clin Epidemiol*, 68(1), 44-51. doi:10.1016/j.jclinepi.2014.09.017

- van Dijke, A., Ford, J. D., van der Hart, O., van Son, M., van der Heijden, P., & Buhning, M. (2012). Complex posttraumatic stress disorder in patients with borderline personality disorder and somatoform disorders. *Psychological Trauma: Theory, Research, Practice, and Policy*, 4(2), 162-168. doi:<http://dx.doi.org/10.1037/a0025732>
- Varese, F., Smeets, F., Drukker, M., Lieveise, R., Lataster, T., Viechtbauer, W., . . . Bentall, R. P. (2012). Childhood adversities increase the risk of psychosis: a meta-analysis of patient-control, prospective- and cross-sectional cohort studies. *Schizophr Bull*, 38(4), 661-671.
doi:10.1093/schbul/sbs050
- Weathers, F. W., Blake, D. D., Schnurr, P. P., Kaloupek, D. G., Marx, B. P., & Keane, T. M. (2013). *The Life Events Checklist for DSM-5 (LEC-5)*. www.ptsd.va.gov: National Center for PTSD.
- World Health Organization. (2004). ICD-10 : international statistical classification of diseases and related health problems : tenth revision. In (2nd ed ed.). Geneva: World Health Organization.
- World Health Organization. (2017). Cardiovascular Diseases (CVDs). Retrieved from [https://www.who.int/news-room/fact-sheets/detail/cardiovascular-diseases-\(cvds\)](https://www.who.int/news-room/fact-sheets/detail/cardiovascular-diseases-(cvds))
- World Health Organization. (2018). ICD-11 : international statistical classification of diseases and related health problems : eleventh revision. In. Geneva: World Health Organization.

Table 1. Sociodemographic characteristics for the Irish (N = 1,020) and UK (N = 1,051) samples.

	Irish sample	UK sample
Sex		
Male	49.0% (n = 500)	31.6% (n = 332)
Female	51.0% (n = 520)	68.4% (n = 719)
Employment status		
Employed/retired/student/homemaking	91.4% (n = 932)	92.9% (n = 976)
Unemployed	8.6% (n = 88)	7.1% (n = 75)
Educational status		
Attended university	53.7% (n = 548)	62.7% (n = 659)
Did not attend university	46.3% (n = 472)	37.3% (n = 392)
Age		
	Mean = 43.1 years	Mean = 47.28 years
	(SD = 15.1, range =	(SD = 15.0, range =
	18-87)	18-90)

Table 2. SEM results for somatic problems in the Irish sample (N = 1,020) and cardiovascular disease load in the UK sample (N = 1,051).

	χ^2	df	CFI	TLI	RMSEA (90% CI)	SRMR
Irish sample: Somatic Problems						
Model 1: Direct effects only	3089.53	193	.640	.598	.121 (.118, .125)	.185
Model 2: Indirect effects only	875.39	181	.914	.897	.061 (.057, .065)	.059
Model 3: Direct and indirect effects	934.53	179	.906	.887	.064 (.060, .068)	.057
UK sample: CVD Load						
Model 1: Direct effects only	836.38	103	.611	.543	.082 (.077, .088)	.182
Model 2: Indirect effects only	199.79	91	.942	.923	.034 (.027, .040)	.126
Model 3: Direct and indirect effects	199.83	89	.941	.920	.034 (.028, .041)	.127

Note: All χ^2 results are statistically significant ($p < .001$); Best fitting models in bold.

Table 3. Direct and indirect standardized regression coefficients derived from Model 2 in the Irish sample ($N = 1,020$).

	β	SE	p
Direct associations			
CPSA \rightarrow PTSD	.12	.04	.001
CPSA \rightarrow DSO	.10	.04	.004
CEAN \rightarrow PTSD	.34	.04	< .001
CEAN \rightarrow DSO	.37	.04	< .001
PTSD \rightarrow Somatic Problems	.30	.05	< .001
DSO \rightarrow Somatic Problems	.38	.05	< .001
Indirect associations			
CPSA \rightarrow PTSD \rightarrow Somatic Problems	.04	.01	.003
CPSA \rightarrow DSO \rightarrow Somatic Problems	.04	.02	.007
CEAN \rightarrow PTSD \rightarrow Somatic Problems	.10	.02	< .001
CEAN \rightarrow DSO \rightarrow Somatic Problems	.14	.02	< .001
R²	without covariates		with covariates
PTSD	.190 ($p < .001$)		.252 ($p < .001$)
DSO	.207 ($p < .001$)		.282 ($p < .001$)
Somatic Problems	.376 ($p < .001$)		.398 ($p < .001$)

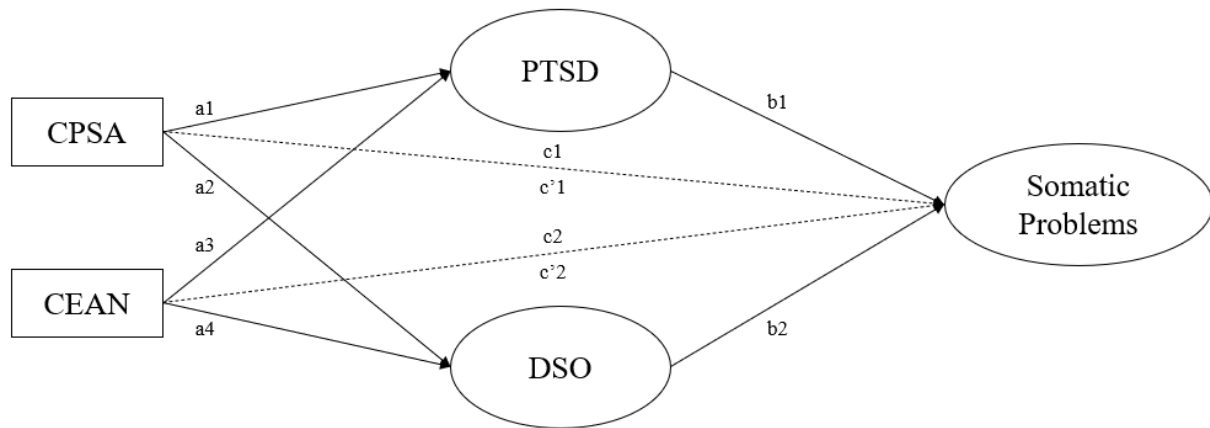
Note: All direct and indirect regression effects are adjusted for sex, age, employment status, and education status; R^2 = percentage of variance explained; CPSA = childhood physical or sexual abuse; CEAN = childhood emotional abuse or neglect; PTSD = posttraumatic stress disorder symptoms; DSO = disturbances in self-organization symptoms; β = standardized regression coefficient; SE = standard error; p = statistical significance.

Table 4. Direct and indirect standardized regression coefficients derived from Model 2 in the UK sample ($N = 1,051$).

	β	SE	p
Direct associations			
CPSA \rightarrow PTSD	.18	.03	< .001
CPSA \rightarrow DSO	.08	.03	.014
CEAN \rightarrow PTSD	.22	.04	< .001
CEAN \rightarrow DSO	.34	.03	< .001
PTSD \rightarrow CVD load	.28	.07	< .001
DSO \rightarrow CVD load	.09	.06	.15
Indirect associations			
CPSA \rightarrow PTSD \rightarrow CVD load	.05	.02	.001
CPSA \rightarrow DSO \rightarrow CVD load	.01	.01	.21
CEAN \rightarrow PTSD \rightarrow CVD load	.06	.02	< .001
CEAN \rightarrow DSO \rightarrow CVD load	.03	.02	.15
R²	without covariates		with covariates
PTSD	.144 ($p < .001$)		.240 ($p < .001$)
DSO	.182 ($p < .001$)		.322 ($p < .001$)
CVD load	.133 ($p < .001$)		.283 ($p < .001$)

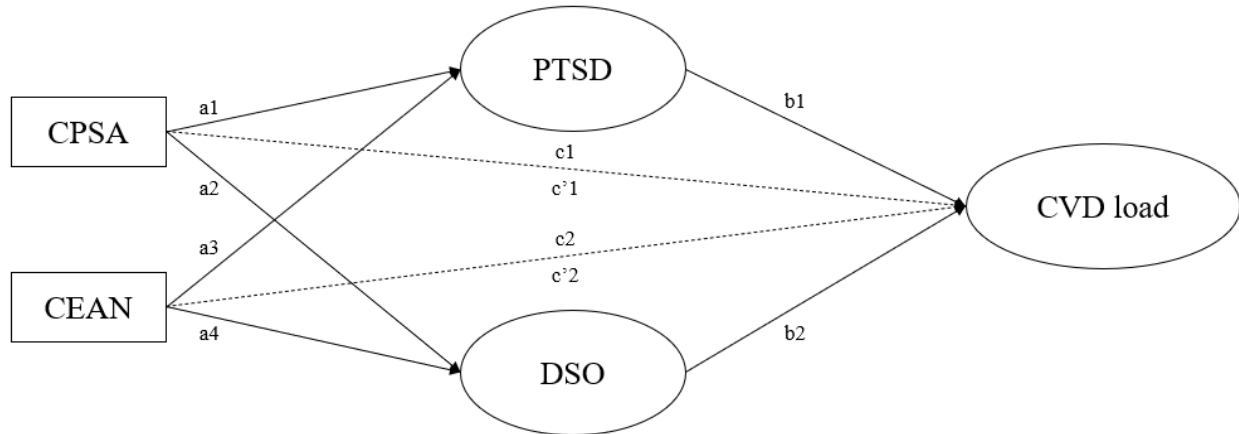
Note: All direct and indirect regression effects are adjusted for sex, age, employment status, and education status; R^2 = percentage of variance explained; CPSA = childhood physical or sexual abuse; CEAN = childhood emotional abuse or neglect; PTSD = posttraumatic stress disorder symptoms; DSO = disturbances in self-organization symptoms; β = standardized regression coefficient; SE = standard error; p = statistical significance.

Figure 1. SEM model of Somatic Problems in the Irish sample ($N = 1,020$).



Note: Model 1 = a and b paths are fixed to zero and c paths are freely estimated; Model 2 = a and b paths are freely estimated and c paths are fixed to zero; Model 3 = a, b, and c paths are freely estimated; PTSD, DSO, and Somatic Problems were regressed onto the covariates of sex, age, employment status, and educational status in all cases. The covariates are not illustrated for the sake of simplicity; CPSA = childhood physical or sexual abuse; CEAN = childhood emotional abuse or neglect; PTSD = posttraumatic stress disorder symptoms; DSO = disturbance in self-organisation symptoms.

Figure 2. SEM model of cardiovascular disease (CVD) load in the UK sample ($N = 1,051$).



Note: Model 1 = a and b paths are fixed to zero and c paths are freely estimated; Model 2 = a and b paths are freely estimated and c paths are fixed to zero; Model 3 = a, b, and c paths are freely estimated; PTSD, DSO, and CVD load were regressed onto the covariates of sex, age, employment status, and educational status in all cases. The covariates are not illustrated for the sake of simplicity; CPSA = childhood physical or sexual abuse; CEAN = childhood emotional abuse or neglect; PTSD = posttraumatic stress disorder symptoms; DSO = disturbance in self-organisation symptoms.