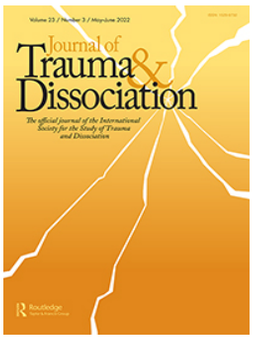

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The Role of Attachment Style, Adverse Childhood Experiences and Dissociation in Migraine

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ABSTRACT

Migraine and chronic migraine are caused by a combination of modifiable and non-modifiable genetic, social, behavioral and environmental risk factors. Further research of possible modifiable risk factors for this headache disorder is merited, given its role as one of the leading causes of years lived with disability per year. The first aim of this online cross-sectional study was to investigate the psychosocial risk factors that predicted chronic migraine and severe migraine-related disability in 507 Irish and UK participants, focusing specifically on childhood maltreatment, attachment and tendency to dissociate, or experience depressed mood and/or anxiety. Additionally, this study aimed to examine variables that mediated the relationships between these psychosocial risk factors and migraine chronicity or severe migraine-related disability. Adjusted binary logistic regression revealed that shutdown dissociation (Odds Ratio [OR] 4.57, 95% Confidence Interval [CI] 2.66–7.85) and severe physical abuse (OR 4.30, 95% CI 1.44–12.83 had significant odds of predicting migraine chronicity, while depression (OR 3.28, 95% CI 1.86–5.77) significantly predicted severe migraine-related disability. Mediation analyses indicated that shutdown dissociation mediated the relationship between seven predictor variables and both chronicity and severe disability including possible predisposing factors emotional abuse, physical neglect, avoidant attachment and anxious attachment. These findings suggest that early life stressors (such as childhood trauma and avoidant attachment style), shutdown dissociation and depression may impact on migraine trajectory. To investigate whether these psychosocial factors are risk factors for migraine chronicity or disability, prospective research should be conducted in this area to account for fluctuations in migraine chronicity over time.

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Introduction

The burden of migraine

Despite 30 years of global research documenting the burden of headache disorders, they have remained one of the leading cause of years lived with disability worldwide (Feigin et al., 2019; James et al., 2018). Migraine and headache disorders are highlighted as an area of focus for reducing global disability (Saylor & Steiner, 2018; World Health Organization [WHO], 2011) and have been undiagnosed, underestimated and undertreated across health-care systems (Buse et al., 2009; Lipton et al., 1992; Wang et al., 2000). Chronic migraine, affecting roughly 2–3% of the global population (Buse et al., 2012; Natoli et al., 2010), has been associated with changes in brain structure (Planchuelo-Gomez et al., 2020), increased economic burden (Blumenfeld et al., 2011; Munakata et al., 2009), psychiatric comorbidity (Chen et al., 2012), medication overuse (Lipton et al., 2019), headache-related disability (Adams et al., 2015) and risk of further health problems including respiratory (Buse et al., 2010; Chen et al., 2012) and cardiovascular disorders (Buse et al., 2020; Schurks et al., 2009).

Risk factors for chronic migraine

Progression from episodic to chronic migraine originates from a combination of genetic, social, behavioral and environmental risk factors (Breslau & Rasmussen, 2001; Lipton & Bigal, 2005; Probyn et al., 2017). Research on risk factors for chronic migraine progression demonstrated strongest evidence for headache frequency, depression and medication overuse, but called for further investigation into modifiable risks; including psychosocial factors (Buse et al., 2019; Xu et al., 2020). Depression is the only significant psychosocial risk factor identified thus far, with anxiety and stress mentioned as having an insufficient number of prospective or case-control studies (Buse et al., 2019; Xu et al., 2020).

Predisposing psychosocial risk factors in migraine

Despite these findings, exposure to repeated stress has been implicated in contributing to allostatic load and causing lasting structural and functional changes in the brain (Borsook et al., 2012). Psychosocial constructs measuring early stress such as childhood trauma and insecure attachment styles could offer additional insight into mechanisms that explain the association between stress and migraine (Ehrlich & Cassidy, 2019). Retrospective research into childhood maltreatment has demonstrated significant odds ratios for migraine, identifying emotional abuse as having the greatest impact on migraine above all other forms of trauma (Tietjen, 2016; Tietjen et al.,

2010a, 2015, 2017) even after adjusting for anxiety and depression (Tietjen et al., 2015, 2017). However, such research has not compared emotional, physical and sexual adverse experiences using one validated measure, in episodic and chronic migraine. The attachment system has been described as a hardwired biological system arising from the threat or fear system, which can foster adequate careseeking and caregiving behavior (McCluskey & O'Toole, 2019). Insecure attachment has been identified as more prevalent in migraine groups across five studies (Esposito et al., 2013; Savi et al., 2005; Tarantino et al., 2017a, 2018; Williams et al., 2017). Anxious attachment and not avoidant attachment is more associated with increased headache intensity and frequency in child and adult samples (Berry & Drummond, 2014; Tarantino et al., 2017a), however, there is a need for additional research comparing both dimensions using larger samples.

Perpetuating psychosocial risk factors in migraine

Investigating the interplay of historical predisposing risk factors in migraine, such as ACE and insecure attachment, with current, perpetuating factors in migraine such as dissociation and psychiatric comorbidity could help better explain the onset and chronification of this disorder. For instance, a history of childhood trauma (Tietjen et al., 2007, 2010a) and insecure attachment (Mula et al., 2016; Rossi et al., 2005; Tarantino et al., 2017a; Williams et al., 2017) has been associated with comorbid anxiety and depression in migraineurs, highlighting a possible explanatory role in impacting migraine. However, these findings merit clarification both with mediation analyses and adjusted regression models using migraine characteristics such as chronicity and disability as outcomes. Similarly, dissociation has been implicated in explaining the relationship between ACE or trauma and migraine, including psychoform dissociative symptoms (e.g., amnesia, depersonalization, derealization and absorption) and somatoform dissociative symptoms (e.g., anesthesia, analgesia, pain symptoms). However, research has generally been limited in analyses and requires further investigation using adjusted regression or mediation analyses to (Arik et al., 2008; Kucukgoncu et al., 2014; Özsoy & Taşci, 2021; Saçmacı et al., 2020).

Theories integrating biopsychosocial factors to explain the impact of recent or historical stress on intense emotions or defense mechanisms such as dissociation merit consideration, particularly with physiological (Steppacher et al., 2016; Szabó et al., 2019) and psychological (Galli et al., 2017; R. A. Nicholson et al., 2007) differences documented in how migraineurs manage emotion. There remains a lack of consensus in defining dissociation, given the purported range of related phenomena and etiological causes (Van der Hart,

2021). However, research has offered insight into the biopsychosocial determinants of dissociation resulting from recent or historical trauma (Lanius et al., 2012; Nijenhuis et al., 2002; Schauer & Elbert, 2010; Van Dijke et al., 2015).

One such construct known as the defense cascade model provides insight into six behavioral reactions to danger and sympathetic and parasympathetic responses of the autonomic nervous system (ANS) including shutdown dissociation which is considered a progression on this model that enhances survival (Schalinski et al., 2015; Schauer & Elbert, 2010). Shutdown dissociation is considered a neurobiological response to stress associated with a shutting down of motor sensory and speech systems and parasympathetic dominance of the ANS (Schauer & Elbert, 2010). Given the impact of dissociation and the ANS in migraine (Miglis, 2018), measuring shutdown dissociation may offer additional insight into the psychosocial risk factors of this headache disorder.

Study aims

Research has argued for continued work into understanding and reducing the burden of chronic migraine (May & Schulte, 2016; Steiner et al., 2018). Limited research has investigated the impact of psychosocial risk factors across episodic and chronic migraine groups, opting instead for control or mixed headache groups. This study had two aims, the first of which was to investigate whether psychosocial risk factors such as childhood maltreatment, attachment and having a tendency to dissociate, or experience depressed mood and/or anxiety predicted chronic migraine or severe migraine-related disability. The second aim was to examine what variables mediated the relationships between psychosocial risk factors and migraine chronicity or severe migraine-related disability.

Method

Participants

Participants were recruited to take part in a cross-sectional online study involving nine self-report questionnaires. Participants were excluded if they did not attend a health professional for migraine, reported having a different headache disorder and not migraine, or confounding health problems, such as space-occupying tumors. Participants were included if they were age 18 or older, living in Ireland or the UK, experienced migraine and had attended a health professional regarding migraine. Participants were classified as having episodic or chronic migraine and little, mild, moderate or severe disability respectively.

Measures

Demographic questionnaire

A 14-item demographic questionnaire was developed and included age, sex, occupation and working hours per week, and health-related information such as headache diagnosis, and health professional attended.

Chronic migraine

The Identify Chronic Migraine (ID-CM; Lipton et al., 2016) is a 12-item screening tool for chronic migraine, measuring headache frequency, headache symptoms, medication use and the impact of headache on activities and making plans. Six items relating to symptoms and making plans use four-point Likert scales and six items are open-ended questions for migraine frequency, medication and activity. This measure has a sensitivity of 80.6%, a specificity of 88.6%, a negative predictive value of 75.0% and a positive predictive value of 91.5%.

Migraine-related disability

The Migraine-Related Disability Assessment Questionnaire (MIDAS; Stewart et al., 2001) is a five-item questionnaire that measures missed days off work or school, household and family or social activities and reduced productivity in work or school and house activities in the last 3 months (Stewart et al., 2001). It classifies participants into four grades, Grade 1: Little or no disability (0–5), Grade 2: Mild disability (6–10), Grade 3: Moderate disability (11–20) and Grade 4: Severe disability (21+). The MIDAS has demonstrated acceptable internal consistency (Stewart, Lipton, Kolodner et al., 1999; Stewart, Lipton, Whyte et al., 1999) and validity in comparison to a diary-based assessment tool (Stewart et al., 2000).

Childhood trauma questionnaire-short form

The Childhood Trauma Questionnaire-Short Form (CTQ-SF; Bernstein et al., 2003) is a 28-item retrospective measure of five areas of maltreatment: physical, sexual and emotional abuse and emotional and physical neglect. It has demonstrated good internal consistency and criterion-related validity (Bernstein et al., 2003). Responses for each item are given on a 5-point Likert scale. Levels of maltreatment were quantified as "None or Minimal," "Low to Moderate," "Moderate to Severe" and "Severe to Extreme" using cut off scores from Bernstein et al. (2003). Cronbach's alpha scores for emotional abuse, physical abuse, sexual abuse, emotional neglect and physical neglect were of .890, .861, .954, .935 and .715 respectively.

Attachment

The Experiences in Close Relationships – Relationship Structures Questionnaire (ECR-RS; Fraley et al., 2011) incorporates nine items that measure current attachment anxiety and avoidance in close relationships in general on a seven-point Likert scale. Using continuous scales that measure avoidant and anxious attachment dimensions gives a more precise representation of adult attachment than the four categories of attachment (e.g., secure, or preoccupied attachment; Brennan et al., 1998). This is particularly the case given that true attachment typology is uncertain and instead categories are considered regions in a two-dimensional space (Fraley & Waller, 1998). One month test-retest reliability of the individual scales has been found to be approximately 0.65 for romantic relationships and 0.80 for parental relationships (Fraley et al., 2011). Higher average scores suggest increased levels of anxious and avoidant attachment with suggested cut offs based off a normative sample of over 17,000 online participants. A Cronbach's alpha of .872 was found for the ECR-RS in this sample.

Dissociation

The Dissociative Experiences Scale-II (DES-II; Carlson & Putnam, 1993) is a 28-item screen for psychoform dissociative symptoms namely amnesia, depersonalization or derealization and absorption. Participants rate each item according to what percentage of the time these symptoms happen to them using an 11-point Likert scale from 0 to 100. The DES-II has been used in a range of mental health populations (Lyssenko et al., 2018). A cut off score of 30 or more is considered in the severe dissociative range and indicative of a need for follow up with structured clinical assessment. Good internal reliability and construct validity have been demonstrated for this measure (Carlson & Putnam, 1993; Zingrone & Alvarado, 2001). A Cronbach's alpha of .930 was found for this measure in the present study.

The Shutdown Dissociation Scale (Shut-D; Schalinski et al., 2015) is a 13-item measure of dissociative experiences in the last six months. Responses were recorded on a four-point Likert scale and summed scores range from 0 to 39. Originally this questionnaire was used as an interview to be applicable in resource-poor settings, but has been used as a self-report questionnaire in this study for large scale data collection. Shut-D has been shown to have good psychometric characteristics, demonstrating good internal consistency, excellent retest reliability and high convergent validity and satisfactory predictive validity (Schalinski et al., 2015). Notably, its high convergent validity was documented with significant associations with all subscales of the Dissociative Experiences Scale (DES; Bernstein & Putnam, 1986). A Cronbach's alpha of .837 was found for the SHUT-D in this study.

Depression

The Patient Health Questionnaire-8 (PHQ-8; Kroenke & Spitzer, 2002) measures eight of nine criteria for depressive disorders (American Psychiatric Association [APA], 2013; Kroenke et al., 2009). It omits the 9th criteria relating to suicidal or self-injurious thoughts to account for the use of online anonymous questionnaires in this survey with no opportunity for follow-up. Participants rate symptoms experienced over the last 2 weeks using a four-point Likert scale. Items are summed and range from 0 to 24. The PHQ-8 has minimally reduced sensitivity but similar specificity and cut offs for depression severity as the Patient Health Questionnaire-9 (PHQ-9; Kroenke & Spitzer, 2002; Wu et al., 2019). A Cronbach's alpha of .894 was found for the PHQ-8 in this study.

Anxiety

The General Anxiety Disorder-7 (GAD-7; Spitzer et al., 2006) measures seven anxiety symptoms experienced over the last 2 weeks. Participants rate symptoms experienced over the last 2 weeks using a four-point Likert scale with responses summed and ranging from 0 to 21. Cut off scores of five, 10 and 15 have been considered for mild, moderate and severe symptoms, with 10 being a reasonable score indicative of GAD. The GAD-7 is reported to have excellent internal consistency and good test–retest reliability (Spitzer et al., 2006). A Cronbach's alpha of .918 was found for the GAD-7 in this sample. *Procedure*

Ethical approval was granted by the National University of Ireland, Galway Research Ethics Committee. Participants were invited to take part in an online study via press release, social media and organization mailing lists such as The Migraine Association of Ireland. The online survey was accessed in LimeSurvey (Schmitz, 2012) and took approximately 30 minutes to complete. Participants gave informed consent prior to beginning this survey. Data were inputted into SPSS Statistics version 26 (IBM Corp, 2019) for analysis.

Data analysis

A priori analyses were conducted on G*Power for regression models depending on best fit (Faul et al., 2009). For instance, for a two-tailed binomial logistic regression, the minimum required sample size of 325 participants was determined using the input parameters: effect size OR = 2; $\alpha = 0.05$; $1\text{-}\beta = 0.95$. Data were first explored using descriptive statistics reviewing demographic and psychological variables such as gender and CTQ respectively. Bivariate correlations, t-tests, one-way analyses of variance (ANOVA) were then conducted, followed by adjusted binary logistic regression to assess relationships between predictor variables and the outcome variables: migraine chronicity and migraine-related disability. Alternative outcome variables were each included as predictors in adjusted regression models, in accordance with past research

(Dodick et al., 2016; Scher et al., 2017). Mediation analyses using PROCESS version 3.4 (Hayes, 2019) were conducted to assess indirect effects between outcome and predictor variables.

Results

Preliminary analysis

A total 1461 individuals took part in the online survey, of which 507 were eligible for analysis. The other 954 participants did not begin (424), or complete (493) the survey, or met exclusion criteria (37). Demographic and outcome variables of participants, are presented in Table 1. Participants meeting criteria for episodic migraine and chronic migraine were 339 and 168 respectively; while 64, 64, 75 and 299 participants were categorized as having little, mild, moderate and severe disability]. Five participants provided invalid responses for all questions in the MIDAS regarding the number of days they were impacted by their migraine and as such were excluded from analysis of migraine-related disability.

Significant between group differences between episodic and chronic groups were noted in key demographic data in Tables 2 and 3, such as gender, χ^2 (1, 507) = 11.69 p = .001, work hours per week, $t(284.70) = -4.00$, $p < .001$ and number of health professionals seen, $t(301.28) = -5.64$, $p < .001$. As per Table 3, mean scores for chronic migraine were significantly higher in all psychosocial variables except for CTQ scales sexual abuse, $t(505) = -0.96$, $p = .339$, emotional neglect, $t(505) = -1.24$, $p = .215$ and physical neglect, $t(505) = -1.58$ $p = .115$. The most notable differences among psychosocial variables were shut down dissociation, $t(269.66) = -8.17$, $p = <.001$, and depression t $(294.33) = -7.46$, $p = <.001$ with significant effect sizes ($d = 0.81$; $d = 0.72$) respectively.

As shown in Tables 4 and 5, significant differences were noted between disability categories 1–3 (little/mild/moderate) and category 4 (severe) in key demographic data such as gender, χ^2 (1, 502) = 22.97 $p < .001$, migraine chronicity, χ^2 (1, 502) = 88.98 $p < .001$ and number of health professionals seen $t(479.01) = 6.26$, $p < .001$. Participants with severe disability endorsed having increased migraine chronicity, working less and seeing more health professionals. Furthermore, as per Table 5, mean differences in 13 of 16 psychological variables were significantly different when comparing both category groups. Notable differences were depression $t(491.09) = -8.91$, $p = <.001$, anxiety $t(469.72) = -5.04$, $p = <.001$ and shutdown $t(500) = -5.70$, $p = <.001$ with notable effect sizes ($d = 0.74$; $d = 0.46$; $d = 0.42$) respectively.

Table 1. Demographic and personal characteristics of participants.

Variable	Frequency (%) or M (SD)	Variable	Frequency (%) or M (SD)
Gender		ID-CM	
Male	51 (10.1%)	Episodic	339 (66.9%)
Female	456 (89.9%)	Chronic	168 (33.1%)
Age	39.77 (10.04)	MIDAS	
		MIDAS Score	34.27 (40.09)
Nationality		I Little/No Disability	64 (12.6%)
Irish	329 (64.9%)	II Mild Disability	64 (12.6%)
British	146 (28.8%)	III Moderate Disability	75 (14.8%)
Other Nationality	32 (6.3%)	IV Severe Disability	299 (59.0%)
		Missing	5 (1.0%)
Residence		CTQ	
Ireland	358 (70.6%)	Participants reporting moderate-extreme ACE	238 (46.9%)
United Kingdom	149 (29.4%)		
Relationship Status		CTQ Emotional Abuse	9.96 (5.23)
Single/Cohabiting	256 (50.1%)	None-Minimal	247 (48.7%)
Married	214 (42.2%)	Slight-Moderate	124 (24.5%)
Separated/Divorced/ Widowed	37 (7.3%)	Moderate-Severe	50 (9.9%)
		Severe-Extreme	86 (17%)
Educational Level			
Primary School	4 (0.8%)	CTQ Physical Abuse	6.58 (2.99)
Secondary School	78 (15.4%)	None-Minimal	409 (80.7%)
Higher Certificate	106 (20.9%)	Slight-Moderate	42 (8.3%)
Undergraduate Degree	163 (32.1%)	Moderate-Severe	20 (3.9%)
Masters Degree	119 (23.5%)	Severe-Extreme	36 (7.1%)
Doctorate Degree	33 (6.5%)		
Other	4 (0.8%)	CTQ Sexual Abuse	6.68 (4.37)
		None-Minimal	404 (79.7%)
Occupation Code		Slight-Moderate	29 (5.7%)
Employed	370 (73%)	Moderate-Severe	26 (5.1%)
Carer/Parent	27 (5.3%)	Severe-Extreme	48 (9.5%)
Student	36 (7.1%)		
Unemployed	48 (9.4%)	CTQ Emotional Neglect	10.98 (5.34)
Retired	22 (4.3%)	None-Minimal	239 (47.1%)
Missing	4 (0.8%)	Slight-Moderate	142 (28%)
		Moderate-Severe	52 (10.3%)
Reported Migraine Diagnosis		Severe-Extreme	74 (14.6%)
Migraine	415 (81.9%)		126
Migraine and comorbidity	92 (18.1%)	CTQ Physical Neglect	7.47 (3.09)
Have not received diagnosis	32 (6.3%)	None-Minimal	305 (60.2%)
		Slight-Moderate	81 (16.0%)
		Moderate-Severe	85 (16.8%)
		Severe-Extreme	36 (7.1%)

ID-CM = Identify Chronic Migraine, MIDAS = Migraine Disability Assessment Test, CTQ = Childhood Trauma Questionnaire.

Binary logistic regression

Two hierarchical logistic regression analyses were performed to determine which variables independently predicted headache chronicity and disability, using episodic headache and little/no-moderate disability as reference categories. Collinearity diagnostics were conducted using the mean VIF of the logit for each model; there was no evidence of multicollinearity (mean VIF of 1.52 for both outcomes respectively). The logit linearity assumption was determined by multiplying continuous predictors by their respective log

Table 2. Descriptive statistics for categorical variables by chronicity.

Variable	Episodic	Chronic	χ^2	*p*
	Frequency (%)	Frequency (%)		
Gender				
Male	45 (8.9%)	6 (1.1%)	11.69	.001**
Female	294 (58.0%)	162 (32.0%)		
Nationality				
Irish	232 (45.8%)	97 (19.1%)	11.36	.003**
British	82 (16.2%)	64 (12.6%)		
Other	25 (4.9%)	7 (1.4%)		
Residence				
Ireland	255 (50.3%)	103 (20.3%)	10.47	.001**
United Kingdom	84 (16.6%)	65(12.8%)		
Reported Diagnosis				
Migraine	268 (52.9%)	115 (22.7%)	21.15	<.001**
Have not received a diagnosis	27 (5.3%)	5 (1.0%)		
Migraine and comorbidity	44 (8.7%)	48 (9.5%)		
MIDAS Categories				
I Little/No Disability	58 (11.6%)	6 (1.2%)	89.83	<.001**
II Mild Disability	61 (12.2%)	3 (0.6%)		
III Moderate Disability	66 (13.1%)	9 (1.8%)		
IV Severe Disability	152 (30.3%)	147 (29.3%)		

MIDAS = Migraine Disability Assessment Test
*$p < .05$. **$p < .01$

Table 3. Descriptive statistics for continuous variables by chronicity.

Variable	Episodic	Chronic	*t*	*p*	Cohen's d
	M SD	*M SD*			
MIDAS Total Score	20.96 (20.79)	69.62 (55.03)	−13.90	<.001**	1.35
Age	39.78 (10.06)	39.39 (10.18)	0.86	.390	0.04
Work Hours per Week	35.15 (11.21)	31.50 (12.14)	−4.00	<.001**	0.32
Sleep	7.02 (.96)	7.16 (1.23)	−1.57	.117	0.13
Unprescribed Drug use (days)	8.65 (19.44)	16.53 (26.52)	−1.36	.176	0.36
No. of Health Professionals seen	1.59 (.92)	1.96 (.91)	−5.64	<.001**	0.40
CTQ Emotional Abuse	9.22 (4.63)	11.92 (6.17)	−2.71	.007**	0.52
CTQ Physical Abuse	6.35 (2.51)	7.19 (3.94)	−2.41	.017*	0.28
CTQ Sexual Abuse	6.44 (3.90)	7.31 (5.39)	−0.96	.339	0.20
CTQ Emotional Neglect	10.38 (4.95)	12.60 (6.01)	−1.24	.215	0.42
CTQ Physical Neglect	7.22 (3.01)	8.13 (3.20)	−1.58	.115	0.30
ECR-RS Avoidance	3.45 (1.38)	3.60 (1.20)	−2.01	.045*	0.11
ECR-RS Anxiety	3.54 (1.78)	4.29 (1.84)	−3.49	.001**	0.42
DES-II	11.89 (9.95)	17.03 (14.30)	−4.07	<.001**	0.44
Shut D	6.39 (4.26)	10.30 (5.78)	−8.17	<.001**	0.81
PHQ-8	6.80 (4.85)	10.50 (5.64)	−7.46	<.001**	0.72
GAD-7	7.12 (5.17)	8.80 (5.41)	−3.18	.002**	0.32

MIDAS = Migraine Disability Assessment Test, CTQ = Childhood Trauma Questionnaire, ECR-RS = Experiences in Close Relationships-Relationship Structures Questionnaire, DES-II = Dissociative Experiences Scale-II, Shut D = Shutdown Dissociation Scale, PHQ-8 = Patient Health Questionnaire-8, GAD-7 = General Anxiety Disorder-7
*$p < .05$. **$p < .01$

transformations, with significant interactions indicating a violation of linearity (Stoltzfus, 2011). There was evidence of log linearity violations for all continuous variables other than participant age. Therefore, other than age, all continuous variables with established cut off thresholds (CTQ, PHQ-8, GAD-7, ECR-RS) were categorized accordingly. However, continuous variables with no standardized cut offs (DESII, SHUT D) were dichotomized based on the empirical optimal cut off point, whereby a threshold with the maximum

Table 4. Descriptive statistics for categorical variables according to level of disability.

Variable	MIDAS I II & III	MIDAS IV	χ^2	*p*
	Frequency (%)	Frequency (%)		
Gender				
Male	36 (7.2%)	14 (2.8%)	22.97	<.001**
Female	167 (33.3%)	285 (56.8%)		
Nationality				
Irish	152 (30.3%)	174 (34.7%)	15.25	<.001**
British	40 (8.0%)	104 (20.7%)		
Other	11 (2.2%)	21 (4.2%)		
Residence				
Ireland	161 (32.1%)	194 (38.6%)	12.15	<.001**
United Kingdom	42 (8.4%)	105(20.9%)		
Reported Diagnosis				
Migraine	160 (31.9%)	219 (43.6%)	12.74	.002**
Have not received a diagnosis	19 (3.8%)	13 (2.6%)		
Migraine and comorbidity	24 (4.8%)	67 (13.3%)		
ID-CM Migraine Chronicity				
Episodic	185 (36.%)	152 (30.3%)	88.98	<.001**
Chronic	18 (3.6%)	147 (29.3%)		

MIDAS I II III IV = Migraine Disability Assessment Test Categories Little (I), Mild (II), Moderate (III), and Severe (IV), ID-CM = Identify Chronic Migraine
*$p < .05$. **$p < .01$

Table 5. Descriptive statistics for continuous variables according to level of disability.

Variable	MIDAS Category I, II and III	MIDAS Category IV	*t*	*p*	Cohen's *d*
	M SD	*M SD*			
Age	40.06 (9.68)	39.49 (10.37)	1.41	.160	0.06
Work Hours per Week	35.99 (10.80)	32.41 (12.07)	2.324	.021*	0.31
Sleep	6.99 (.92)	7.10 (1.14)	−.610	.542	0.10
Unprescribed Drug use (days)	8.82 (20.66)	12.71 (22.94)	−.820	.412	0.18
No. of Health Professionals Seen	1.44 (.65)	1.93 (1.07)	−6.26	<.001**	0.53
CTQ Emotional Abuse	8.80 (4.51)	11.03 (5.62)	−3.93	<.001**	0.43
CTQ Physical Abuse	6.35 (2.78)	6.78 (3.16)	−1.95	.052	0.14
CTQ Sexual Abuse	6.28 (3.84)	7.04 (4.78)	−1.46	.145	0.17
CTQ Emotional Neglect	9.84 (4.88)	12.04 (5.54)	−3.19	.002*	0.42
CTQ Physical Neglect	7.10 (3.18)	7.81 (2.96)	−2.50	.013*	0.23
ECR-RS Avoidance	3.56 (1.41)	3.42 (1.26)	−.401	.689	0.11
ECR-RS Anxiety	3.36 (1.73)	4.10 (1.86)	−4.05	<.001**	0.41
DES-II	11.14 (9.91)	15.27 (12.35)	−3.73	<.001**	0.36
Shut D	6.35 (4.32)	8.47 (5.42)	−5.70	<.001**	0.42
PHQ-8	6.05 (4.59)	9.43 (4.59)	−8.91	<.001**	0.74
GAD-7	6.35 (5.08)	8.71 (5.22)	−5.04	<.001**	0.46

MIDAS I II III IV = Migraine Disability Assessment Test Categories Little (I), Mild (II), Moderate (III), and Severe (IV), CTQ = Childhood Trauma Questionnaire, ECR-RS = Experiences in Close Relationships-Relationship Structures Questionnaire, DES-II = Dissociative Experiences Scale-II, Shut D = Shutdown Dissociation Scale, PHQ-8 = Patient Health Questionnaire-8, GAD-7 = General Anxiety Disorder-7
*$p < .05$. **$p < .01$

discriminatory capability based on the area under the receiver operating characteristic (ROC) curve was used (Habibzadeh et al., 2016; Unal, 2017). Although categorizing continuous predictors necessitates larger samples, the number of events in both regressions (203 and 168 for the disability and chronicity outcomes respectively) should be sufficient to avoid over-fitting in accordance with the events-per-variable criteria (Vittinghoff & McCulloch,

2007). Significant predictor variables were determined after adjusting for age, gender, anxiety, depression and headache features (ID-CM, MIDAS), as per Tables 9 and 13.

Migraine chronicity logistic regression

Unadjusted and adjusted logistic regression models for migraine chronicity are presented in Tables 7–9 and for migraine disability in Tables 11–13. Each model significantly contributed to the variance based on log likelihood as shown in Tables 6 and 10. Physical abuse and shutdown independently predicted chronic migraine, after adjusting for disability and psychological and demographic variables such as depression, anxiety, gender and age. As per Table 9, disability was the strongest predictor of chronicity (OR 8.67, 95% CI 4.74–15.87), followed by shutdown dissociation (OR 4.57, 95% CI 2.66–7.85)

Table 6. Binary logistic regression of migraine chronicity.

Model	Pseudo R^2	Log Likelihood	χ^2	*df*	*p*
Step 1 Unadjusted Logistic Regression with 5 CTQ Variables	0.04	−327.47	27.65	15	.024**
Step 2 Unadjusted Logistic Regression with 11 variables	0.10	−267.62	108.79	21	<.001**
Step 3 Adjusted Logistic Regression with 16 variables	0.29	228.33	187.37	26	<.001**

CTQ = Childhood Trauma Questionnaire
*$p < .05$. **$p < .01$

Table 7. Step 1 unadjusted binary logistic regression of migraine chronicity.

Variable	Odds Ratio	95% CI	*p*
Constant	0.45	0.33–0.61	<.001**
CTQ Emotional Abuse			
None-Minimal (reference category)			
Slight-Moderate	1.44	0.87–2.40	.158
Moderate-Severe	1.18	0.55–2.53	.663
Severe-Extreme	3.40	1.54–7.52	.003**
CTQ Physical Abuse			
None-Minimal (reference category)			
Slight-Moderate	0.59	0.26–1.34	.204
Moderate-Severe	1.23	0.44–3.45	.695
Severe-Extreme	2.41	0.96–6.06	.061
CTQ Emotional Neglect			
None-Minimal (reference category)			
Slight-Moderate	0.74	0.44–1.24	.255
Moderate-Severe	1.08	0.51–2.31	.837
Severe-Extreme	0.29	0.12–0.73	.009**
CTQ Physical Neglect			
None-Minimal (reference category)			
Slight-Moderate	0.96	0.53–1.75	.901
Moderate-Severe	0.80	0.43–1.49	.486
Severe-Extreme	1.97	0.81–4.79	.133
CTQ Sexual Abuse			
None-Minimal (reference category)			
Slight-Moderate	0.72	0.30–1.75	.467
Moderate-Severe	1.18	0.49–2.86	.709
Severe-Extreme	0.88	0.43–1.81	.724

CTQ = Childhood Trauma Questionnaire
*$p < .05$. **$p < .01$

Table 8. Step 2 unadjusted binary logistic regression of migraine chronicity.

Variable	Odds Ratio	95% CI	*p*
Constant	0.15	0.09–0.24	<.001**
CTQ Emotional Abuse			
None-Minimal (reference category)			
Slight-Moderate	1.06	0.60–1.85	.845
Moderate-Severe	0.90	0.39–2.05	.799
Severe-Extreme	2.02	0.84–4.84	.115
CTQ Physical Abuse			
None-Minimal (reference category)			
Slight-Moderate	0.55	0.23–1.32	.180
Moderate-Severe	2.06	0.67–6.31	.208
Severe-Extreme	3.17	1.18–8.53	.022*
CTQ Emotional Neglect			
None-Minimal (reference category)			
Slight-Moderate	0.70	0.39–1.24	.216
Moderate-Severe	1.19	0.51–2.77	.691
Severe-Extreme	0.31	0.11–0.87	.025*
CTQ Physical Neglect			
None-Minimal (reference category)			
Slight-Moderate	0.99	0.52–1.88	.970
Moderate-Severe	0.58	0.30–1.12	.105
Severe-Extreme	1.41	0.54–3.63	.482
CTQ Sexual Abuse			
None-Minimal (reference category)			
Slight-Moderate	0.78	0.30–2.03	.604
Moderate-Severe	1.79	0.66–4.82	.250
Severe-Extreme	0.75	0.34–1.66	.479
ECR-RS Anxiety	1.34	0.84–2.15	.224
ECR-RS Avoidance	1.22	0.76–1.97	.416
DES-II	1.09	0.68–1.75	.731
Shut-D	5.60	3.45–9.08	<.001**

CTQ = Childhood Trauma Questionnaire, ECR-RS = Experiences in Close Relationships-Relationship Structures, DES-II = Dissociative Experiences Scale-II, Shut D = Shutdown Dissociation Scale
*$p < .05$. **$p < .01$

and severe physical abuse (OR 4.30, 95% CI 1.44–12.83). In contrast, severe emotional neglect was found to significantly predict episodic migraine (OR 0.20, 95% CI 0.06–0.63).

Migraine disability logistic regression

Emotional abuse (OR 2.90, 95% CI 1.19–7.06) and shutdown dissociation (OR 2.60, 95% CI 1.70–3.98) were noted for predicting severe disability in the unadjusted binary logistic regression (Table 12), however only chronicity (OR 8.37, 95% CI 4.61–15.20) gender (OR 3.37, 95% CI 1.56–7.30) and depression (OR 3.28, 95% CI 1.86–5.77) predicted severe disability in the adjusted model as per Table 13.

Mediation analyses

Parallel multiple mediation analyses using PROCESS (Hayes, 2019) were conducted to investigate the relationship between psychosocial predictors and migraine chronicity and disability. Dichotomous variables such as

Table 9. Step 3 adjusted binary logistic regression of migraine chronicity.

Variable	Odds Ratio	95% CI	*p*
Constant	0.01	<0.00–0.48	<.001**
Age	1.01	0.99–1.04	.216
Gender	2.28	0.81–6.45	.119
MIDAS	8.67	4.74–15.87	<.001**
CTQ Emotional Abuse			
None-Minimal (reference category)			
Slight-Moderate	1.02	0.55–1.89	.946
Moderate-Severe	0.56	0.23–1.38	.210
Severe-Extreme	1.49	0.57–3.84	.415
CTQ Physical Abuse			
None-Minimal (reference category)			
Slight-Moderate	0.52	0.20–1.38	.192
Moderate-Severe	2.96	0.83–10.56	.094
Severe-Extreme	4.30	1.44–12.83	.009**
CTQ Emotional Neglect			
None-Minimal (reference category)			
Slight-Moderate	0.55	0.29–1.05	.069
Moderate-Severe	0.96	0.37–2.48	.931
Severe-Extreme	0.20	0.06–0.63	.006**
CTQ Physical Neglect			
None-Minimal (reference category)			
Slight-Moderate	0.89	0.44–1.81	.747
Moderate-Severe	0.59	0.29–1.22	.155
Severe-Extreme	2.44	0.84–7.05	.100
CTQ Sexual Abuse			
None-Minimal (reference category)			
Slight-Moderate	0.61	0.22–1.71	.345
Moderate-Severe	1.74	0.60–5.00	.307
Severe-Extreme	0.73	0.32–1.68	.460
ECR-RS Anxiety	1.41	0.80–2.46	.233
ECR-RS Avoidance	1.44	0.84–2.46	.186
DES-II	1.06	0.61–1.85	.827
Shut D	4.57	2.66–7.85	<.001**
PHQ-8	1.43	0.81–2.52	.218
GAD-7	0.63	0.34–1.15	.132

MIDAS = Migraine Disability Assessment Test, CTQ = Childhood Trauma Questionnaire, ECR-RS = Experiences in Close Relationships-Relationship Structures, DES-II = The Dissociative Experiences Scale-II, Shut D = The Shutdown Dissociation Scale, PHQ-8 = Patient Health Questionnaire-8, GAD-7 = General Anxiety Disorder-7

*$p < .05$. **$p < .01$

Table 10. Binary logistic regression of migraine disability.

Model	Pseudo R^2	Log Likelihood	χ^2	*df*	*p*
Step 1 Unadjusted Logistic Regression with 5 CTQ Variables	0.04	−327.47	27.65	15	.024
Step 2 Unadjusted Logistic Regression with 11 variables	0.10	−308.39	65.83	19	<.001
Step 3 Adjusted Logistic Regression with 16 variables	0.25	−254.69	173.21	26	<.001

CTQ = Childhood Trauma Questionnaire

*$p < .05$. **$p < .01$

migraine disability and gender, could not be included as mediators, however, available continuous variables such as MIDAS total scores were incorporated into mediation analyses. Exploratory models were conducted using a maximum of seven mediators, however, given the number of variables available, only mediators with significant indirect effects, or approaching significance, were included. Including multiple mediators in a model allows for the analysis of specific indirect effects of a predictor variable (X) on an outcome variable

Table 11. Step 1 unadjusted binary logistic regression of migraine disability.

Variable	Odds Ratio	95% CI	*p*
Constant	1.01	0.76–1.34	.949
CTQ Emotional Abuse			
None-Minimal (reference category)			
Slight-Moderate	1.66	1.03–2.68	.038*
Moderate-Severe	2.53	1.22–5.25	.013*
Severe-Extreme	4.44	1.91–10.33	.001**
CTQ Physical Abuse			
None-Minimal (reference category)			
Slight-Moderate	0.62	0.31–1.24	.173
Moderate-Severe	0.45	0.16–1.27	.134
Severe-Extreme	0.82	0.30–2.26	.699
CTQ Emotional Neglect			
None-Minimal (reference category)			
Slight-Moderate	1.14	0.71–1.86	.585
Moderate-Severe	1.10	0.51–2.35	.809
Severe-Extreme	0.76	0.33–1.73	.514
CTQ Physical Neglect			
None-Minimal (reference category)			
Slight-Moderate	0.88	0.50–1.55	.665
Moderate-Severe	1.37	0.76–2.47	.295
Severe-Extreme	0.83	0.35–1.99	.674
CTQ Sexual Abuse			
None-Minimal (reference category)			
Slight-Moderate	1.35	0.59–3.08	.482
Moderate-Severe	1.08	0.45–2.61	.864
Severe-Extreme	1.02	0.51–2.06	.947

CTQ = Childhood Trauma Questionnaire
*$p < .05$. **$p < .01$

(Y) while holding constant other mediators, however this comes at a cost of decreased power and increased sampling variance (Hayes, 2017). Therefore, these analyses focused on indirect effects of individual mediators rather than total effects for two reasons. Firstly, as outcome variables were dichotomous standardized effect sizes could not be calculated, therefore indirect effects were examined using bootstrapping (BCa) with 5000 bootstrapped samples. Secondly, measuring total effect in mediation is not considered a requirement given its purpose is to test for indirect effects (Agler & De Boeck, 2017) and that competing direct and indirect effects can supress their effects and result in near-zero total effects (MacKinnon et al., 2000). Bootstrapped samples were considered significant ($p < .05$) if 95% confidence intervals (CIs) did not cross zero. A path model conceptualizing a parallel multiple mediation analyses with three mediators is presented in Figure 1.

Mediation analyses for predictors of migraine chronicity

Mediation models for significant indirect effects of psychosocial variables on migraine chronicity are presented in Tables 14–17 respectively. Shutdown dissociation mediated the relationship between seven predictor variables and ID-CM, namely emotional abuse, $b = .20$, Bootstrap 95% Bias Corrected Confidence Interval (BC CI) .01–04, physical neglect, $b = .25$ 95% Bootstrap

Table 12. Step 2 unadjusted binary logistic regression of migraine disability.

Variable	Odds Ratio	95% CI	*p*
Constant	0.61	0.40–0.92	.018
CTQ Emotional Abuse			
None-Minimal (reference category)			
Slight-Moderate	1.30	0.79–2.16	.305
Moderate-Severe	2.10	0.99–4.45	.054
Severe-Extreme	2.90	1.19–7.06	.019*
CTQ Physical Abuse			
None-Minimal (reference category)			
Slight-Moderate	0.56	0.27–1.16	.119
Moderate-Severe	0.56	0.19–1.66	.298
Severe-Extreme	0.78	0.29–2.15	.637
CTQ Emotional Neglect			
None-Minimal (reference category)			
Slight-Moderate	1.25	0.75–2.08	.394
Moderate-Severe	1.32	0.59–2.94	.503
Severe-Extreme	1.02	0.42–2.47	.959
CTQ Physical Neglect			
None-Minimal (reference category)			
Slight-Moderate	0.88	0.49–1.59	.672
Moderate-Severe	1.16	0.62–2.15	.642
Severe-Extreme	0.60	0.24–1.50	.276
CTQ Sexual Abuse			
None-Minimal (reference category)			
Slight-Moderate	1.49	0.63–3.50	.361
Moderate-Severe	1.37	0.55–3.46	.500
Severe-Extreme	0.90	0.43–1.88	.778
ECR-RS Anxiety	1.30	0.84–1.96	.247
ECR-RS Avoidance	2.10	0.50–1.19	.232
DES-II	2.90	0.97–2.30	.066
Shut-D	2.60	1.70–3.98	<.001**

CTQ = Childhood Trauma Questionnaire, ECR-RS = Experiences in Close Relationships-Relationship Structures, DES-II = Dissociative Experiences Scale-II, Shut D = Shutdown Dissociation Scale
*$p < .05$. **$p < .01$

BC CI .01-.05, avoidant attachment (b = .06 95% Bootstrap BC CI .22-.12), anxious attachment (b = .06 95% Bootstrap BC CI .03-.12), psychoform dissociation (b = .03 95% Bootstrap BC CI .01-.05), depression (b = .05 95% Bootstrap BC CI .02-.07) and anxiety (b = .04 95% Bootstrap BC CI .02-.06). Physical abuse mediated the relationship between emotional abuse (b = .03 95% Bootstrap BC CI <.01-.07) and psychoform dissociation (b = <.01 95% Bootstrap BC CI <.01-.01) and chronic migraine; while depression mediated the relationship between anxiety and chronic migraine (b = .04 95% Bootstrap BC CI .01-.09).

Mediation analyses for predictors of migraine disability

Mediation models for significant indirect effects of psychosocial variables on migraine disability are presented in Tables 18–21. Depression mediated nine predictor variables and severe disability specifically, emotional neglect (b = .03 95% Bootstrap BC CI .01-.05), emotional abuse (b = .03 95% Bootstrap BC CI .01-.05), physical neglect (b = .04 95% Bootstrap BC CI .02-.07), sexual abuse (b = .02 95% Bootstrap BC CI <.01-.05), avoidant attachment (b = .21 95%

Table 13. Step 3 adjusted binary logistic regression of migraine disability.

Variable	Odds Ratio	95% CI	*p*
Constant	0.05	0.01–0.29	.001**
Age	1.00	0.98–1.02	.999
Gender	3.37	1.56–7.30	<.001**
ID-CM	8.37	4.61–15.20	<.001**
CTQ Emotional Abuse			
None-Minimal (reference category)			
Slight-Moderate	1.11	0.62–1.97	.725
Moderate-Severe	2.17	0.94–4.99	.069
Severe-Extreme	1.77	0.67–4.68	.253
CTQ Physical Abuse			
None-Minimal (reference category)			
Slight-Moderate	0.70	0.31–1.57	.385
Moderate-Severe	0.48	0.13–1.72	.260
Severe-Extreme	0.68	0.22–2.08	.496
CTQ Emotional Neglect			
None-Minimal (reference category)			
Slight-Moderate	1.43	0.80–2.54	.225
Moderate-Severe	1.32	0.54–3.26	.542
Severe-Extreme	1.45	0.55–3.85	.454
CTQ Physical Neglect			
None-Minimal (reference category)			
Slight-Moderate	0.88	0.46–1.70	.704
Moderate-Severe	1.55	0.78–3.12	.214
Severe-Extreme	0.49	0.18–1.36	.168
CTQ Sexual Abuse			
None-Minimal (reference category)			
Slight-Moderate	1.79	0.72–4.44	.209
Moderate-Severe	1.12	0.39–3.23	.835
Severe-Extreme	1.05	0.46–2.40	.912
ECR-RS Anxiety	0.84	0.50–1.40	.495
ECR-RS Avoidance	0.63	0.39–1.04	.073
Dissociative Experiences Scale-II	1.58	0.95–2.64	.079
Shutdown Dissociation Scale	1.10	0.67–1.83	.700
PHQ-8	3.28	1.86–5.77	<.001**
GAD-7	1.02	0.58–1.79	.949

ID-CM = Identify Chronic Migraine, CTQ = Childhood Trauma Questionnaire, ECR-RS = Experiences in Close Relationships-Relationship Structures, DES-II = The Dissociative Experiences Scale-II, Shut D = The Shutdown Dissociation Scale, PHQ-8 = Patient Health Questionnaire-8, GAD-7 = General Anxiety Disorder-7

*$p < .05$. **$p < .01$

Bootstrap BC CI .13-.31), anxious attachment (b = .18 95% Bootstrap BC CI .11-.27), shutdown (b = .06 95% Bootstrap BC CI .04-.09), psychoform dissociation (b = .03 95% Bootstrap BC CI .02-.04) and anxiety (b = .09 95% Bootstrap BC CI .05-.13).

Shutdown mediated seven predictor variables and severe disability: emotional abuse (b = .01 95% Bootstrap BC CI <.01-.03), physical neglect (b = .02 95% Bootstrap BC CI <.01-.03), avoidant attachment (b = .04 95% Bootstrap BC CI <.01-.08), anxious attachment (b = .04 95% Bootstrap BC CI .01-.08), psychoform dissociation (b = .02 95% Bootstrap BC CI <.01-.03), depression (b = .03 95% Bootstrap BC CI <.01-.05), and anxiety (b = .02 95% Bootstrap BC CI <.01-.04). Lastly, emotional abuse mediated sexual abuse (b = .02 95% Bootstrap BC CI <.01-.04) and avoidant attachment (b = .08 95% Bootstrap BC CI .02-.15) and severe disability respectively.

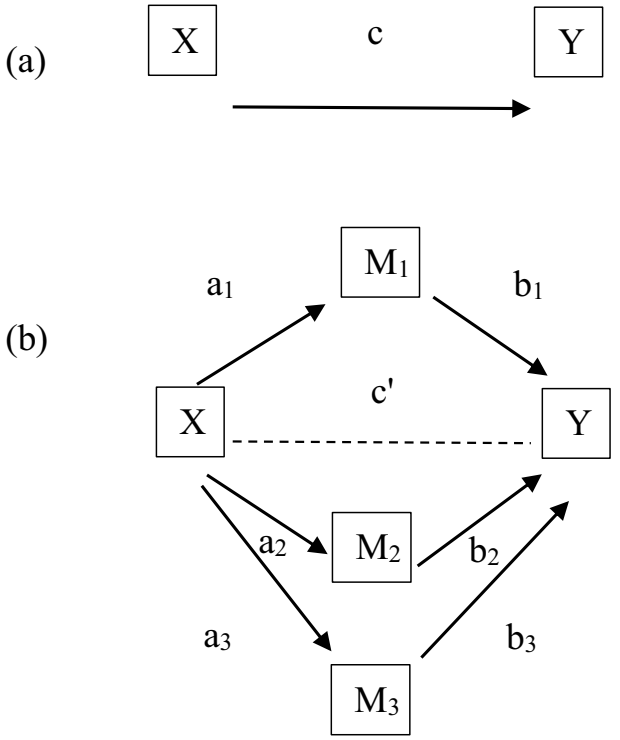

Figure 1. Path model demonstrating (A) total effect of predictor variable (X) on outcome variable (Y) and (B) direct effect (c') between predictor (X) and outcome variable (Y) and indirect effects (a_i, b_i) of mediators (M_i) between predictor (X) and outcome variable (Y).

Table 14. Indirect effects of childhood trauma questionnaire on migraine chronicity.

	Product of Coefficients		Bootstrap 95% BC′ CI	
Indirect Effect	Estimate	SE	LL	UL
CTQ Emotional Abuse				
Total	.1101	.0292	.0609	.1752
MIDAS	.0506	.0180	.0221	.0920
Shut D	.0200	.0079	.0071	.0380
CTQ Physical Abuse	.0341	.0180	.0014	.0723
PHQ8	.0055	.0058	−.0052	.0181
CTQ Physical Neglect				
Total	.0759	.0311	.0231	.1480
Shut D	.0254	.0103	.0089	.0486
MIDAS	.0425	.0273	−.0019	.1059
PHQ-8	.0080	.0090	−.0085	.0274

BC′ CI = Bias Corrected Confidence Interval, 5000 bootstrap sample, CTQ = Childhood Trauma Questionnaire, MIDAS = Migraine Disability Assessment Test, Shut D = Shutdown Dissociation Scale,, PHQ-8 = Patient Health Questionnaire-8

Table 15. Indirect effects of experiences in close relationships-relationship structures on migraine chronicity.

	Product of Coefficients		Bootstrap 95% BC′ CI	
Indirect Effect	Estimate	SE	LL	UL
ECR-RS Avoidant Attachment				
Total	.1646	.0738	.0237	.3145
Shut D	.0626	.0256	.0218	.1193
CTQ Physical Abuse	.0270	.0174	−.0056	.0639
PHQ-8	.0276	.0373	−.0439	.1029
MIDAS	.0475	.0512	−.0497	.1530
ECR-RS Anxious Attachment				
Total	.2752	.0605	.1701	.4069
Shut D	.0629	.0223	.0262	.1126
MIDAS	.1515	.0456	.0785	.2588
CTQ Physical Abuse	.0226	.0133	−.0022	.0512
PHQ-8	.0382	.0389	−.0386	.1150

BC′ CI = Bias Corrected Confidence Interval, 5000 bootstrap sample, Shut D = Shutdown Dissociation Scale, MIDAS = Migraine Disability Assessment Test, PHQ-8 = Patient Health Questionnaire-8, CTQ = Childhood Trauma Questionnaire, ECR-RS = Experiences in Close Relationships-Relationship Structures

Table 16. Indirect effects of dissociation on migraine chronicity.

	Product of Coefficients		Bootstrap 95% BC′ CI	
Indirect Effect	Estimate	SE	LL	UL
Dissociative Experiences Scale II				
Total	.0653	.0134	.0433	.0953
Shut D	.0283	.0080	.0144	.0465
MIDAS	.0264	.0081	.0135	.0446
CTQ Physical Abuse	.0037	.0022	.0002	.0086
PHQ-8	.0069	.0057	−.0038	.0186
Shutdown Dissociation				
Total	.1218	.0251	.0797	.1789
MIDAS	.1081	.0229	.0706	.1608
CTQ Physical Abuse	.0022	.0025	−.0011	.0086
PHQ-8	.0115	.0130	−.0136	.0379

BC′ CI = Bias Corrected Confidence Interval, 5000 bootstrap sample, Shut D = Shutdown Dissociation Scale, MIDAS = Migraine Disability Assessment Test, Shut D = Shutdown Dissociation Scale, CTQ = Childhood Trauma Questionnaire, PHQ-8 = Patient Health Questionnaire-8, GAD-7 = General Anxiety Disorder-7

Table 17. Indirect effects of depression and anxiety on migraine chronicity.

	Product of Coefficients		Bootstrap 95% BC′ CI	
Indirect Effect	Estimate	SE	LL	UL
Depression				
Total	.1522	.0251	.1125	.2095
MIDAS	.1043	.0214	.0708	.1547
Shut D	.0456	.0137	.0206	.0743
CTQ Physical Abuse	.0023	.0023	−.0010	.0078
Anxiety				
Total	.1365	.0254	.0928	.1930
MIDAS	.0579	.0150	.0336	.0923
Shut D	.0347	.0112	.0148	.0586
PHQ-8	.0425	.0201	.0050	.0847
CTQ Physical Abuse	.0014	.0019	−.0017	.0060

BC′ CI = Bias Corrected Confidence Interval, 5000 bootstrap sample, PHQ-8 = Patient Health Questionnaire-8, MIDAS = Migraine Disability Assessment Test, Shut D = Shutdown Dissociation Scale, CTQ = Childhood Trauma Questionnaire, GAD-7 = General Anxiety Disorder-7

Table 18. Indirect effects of childhood trauma questionnaire on migraine disability.

	Product of Coefficients		Bootstrap 95% BC′ CI	
Indirect Effect	Estimate	SE	LL	UL
CTQ Emotional Neglect				
Total	.0284	.0087	.0126	.0475
PHQ-8	.0276	.0090	.0123	.0476
Shut D	.0053	.0037	−.0006	.0137
GAD-7	−.0045	.0052	−.0162	.0044
CTQ Emotional Abuse				
Total	.0387	.0124	.0171	.0664
PHQ-8	.0270	.0077	.0142	.0447
Shut D	.0124	.0056	.0033	.0252
CTQ Sexual Abuse	−.0008	.0079	−.0156	.0161
CTQ Physical Neglect				
Total	.0931	.0261	.0482	.1485
PHQ-8	.0404	.0127	.0194	.0695
Shut D	.0166	.0076	.0044	.0339
CTQ Emotional Abuse	.0361	.0209	−.0030	.0795
CTQ Sexual Abuse				
Total	.0408	.0149	.0146	.0725
PHQ-8	.0241	.0116	.0046	.0492
CTQ Emotional Abuse	.0185	.0096	.0006	.0390
GAD-7	−.0019	.0030	−.0094	.0029

BC′ CI = Bias Corrected Confidence Interval, 5000 bootstrap sample, PHQ-8 = Patient Health Questionnaire-8, Shut D = Shutdown Dissociation Scale, GAD-7 = General Anxiety Disorder-7

Table 19. Indirect effects of ECR-RS on migraine disability.

	Product of Coefficients		Bootstrap 95% BC′ CI	
Indirect Effect	Estimate	SE	LL	UL
ECR-RS Avoidant Attachment				
Total	.3240	.0590	.2234	.4514
PHQ-8	.2054	.0449	.1305	.3068
CTQ Emotional Abuse	.0795	.0326	.0199	.1497
Shut D	.0391	.0190	.0086	.0829
ECR-RS Anxious Attachment				
Total	.2701	.0499	.1816	.3806
PHQ-8	.1838	.0403	.1132	.2724
Shut D	.0403	.0167	.0121	.0769
CTQ Emotional Abuse	.0459	.0269	−.0046	.1019

BC′ CI = Bias Corrected Confidence Interval, 5000 bootstrap sample, ECR-RS = Experiences in Close Relationships-Relationship Structures, PHQ-8 = Patient Health Questionnaire-8, Shut D = Shutdown Dissociation Scale, CTQ = Childhood Trauma Questionnaire

Discussion

Key findings

The aims of this study were to investigate the predictive nature of psychosocial factors in chronic migraine and severe migraine-related disability and examine indirect effects between these variables. There are several significant findings from this research, the first of which indicated psychosocial difficulties were generally more prevalent in chronic than episodic migraine and in severe than in less severe migraine-related disability. Adjusted binary logistic regression revealed that physical abuse, shutdown dissociation and migraine-related disability had significant odds of predicting migraine chronicity, while chronicity and depression significantly predicted severe disability. Not surprisingly,

Table 20. Indirect effects of dissociation on migraine disability.

	Product of Coefficients		Bootstrap 95% BC′ CI	
Indirect Effect	Estimate	SE	LL	UL
Shutdown Dissociation				
Total	.0695	.0145	.0441	.1018
PHQ-8	.0628	.0134	.0394	.0920
CTQ Emotional Neglect	.0001	.0024	−.0048	.0054
CTQ Emotional Abuse	.0066	.0060	−.0045	.0195
Dissociative Experiences Scale II				
Total	.0509	.0086	.0359	.0698
PHQ-8	.0266	.0057	.0169	.0392
Shut D	.0185	.0065	.0064	.0320
CTQ Emotional Abuse	.0052	.0041	−.0025	.0137
CTQ Emotional Neglect	.0006	.0031	−.0056	.0068

BC′ CI = Bias Corrected Confidence Interval, 5000 bootstrap sample, PHQ-8 = Patient Health Questionnaire-8, CTQ = Childhood Trauma Questionnaire, Shut D = Shutdown Dissociation Scale

Table 21. Indirect effects of depression on migraine disability.

	Product of Coefficients		Bootstrap 95% BC′ CI	
Indirect Effect	Estimate	SE	LL	UL
Depression				
Total	.0313	.0146	.0036	.0609
Shut D	.0293	.0110	.0085	.0511
CTQ Emotional Abuse	.0078	.0046	−.0007	.0177
ECR-RS Anxiety	−.0057	.0097	−.0249	.0132
Anxiety				
Total	.1173	.0205	.0818	.1626
PHQ-8	.0895	.0205	.0528	.1338
Shut D	.0219	.0082	.0068	.0394
CTQ Emotional Abuse	.0060	.0039	−.0007	.0146

BC′ CI = Bias Corrected Confidence Interval, 5000 bootstrap sample, Shut D = Shutdown Dissociation Scale, CTQ = Childhood Trauma Questionnaire, ECR-RS = Experiences in Close Relationships-Relationship Structures, PHQ-8 = Patient Health Questionnaire-8, Shut D = Shutdown Dissociation Scale

disability was the highest predictor of chronicity and vice versa given their association and that MIDAS was one of the measures used in developing the ID-CM (Lipton et al., 2016; Manack et al., 2011; Scher et al., 2019). Similarly, while migraine-related disability is considered a secondary outcome, both outcome variables in this study were associated with a range of direct and indirect effects, highlighting the role of this construct in offering additional insight into the impact of migraine alongside chronicity (Andrasik et al., 2005; D'Amico et al., 2013; Leonardi & Raggi, 2013).

Interestingly, physical abuse was the only childhood trauma to predict either outcomes after controlling for confounding variables. Previous research to date has suggested that emotional maltreatment was more prevalent in migraine compared with physical or sexual abuse (Tietjen et al., 2010b, 2016, 2015, 2017). Only one study to date had compared childhood maltreatment between episodic and chronic migraine, documenting emotional abuse as being the highest predictor for chronic migraine and for those that had recently progressed from episodic to chronic, while physical abuse was the

second strongest predictor (Tietjen et al., 2010b). In contrast, this study highlights physical abuse as being a markedly better predictor of chronicity than both emotional neglect and abuse, with notable differences in odds ratios.

Depression was the only predictor of severe disability after migraine chronicity and gender, a finding which is not surprising given its high prevalence in migraine (Minen et al., 2016). Previous research using the Hospital Anxiety and Depression scale demonstrated that migraineurs with both depression and anxiety, but not anxiety or depression alone, have demonstrated increased disability (Lanteri-Minet et al., 2005; Peterlin et al., 2009). However, this study found that increased depression as measured with the PHQ-8 predicted severe disability, consistent with the findings of Seo and Park (2015). Depression, can be argued as being a possible by-product of a natural trajectory. However, at the very least it highlights a complex relationship with migraine, especially given the role depression plays in mediating nine individual relationships between predictor variables and disability including possible predisposing risk factors such as emotional neglect, emotional abuse, physical neglect, sexual abuse, avoidant attachment and anxious attachment. In a similar vein, previous research has documented that depressive symptoms and insecure attachment were the most significant predictors of disability in episodic and chronic migraine (Rossi et al., 2005). Heretofore, psychosocial difficulties in migraine were most commonly assessed under the auspices of psychiatric comorbidity. While assessing mental health in migraine is important, it is not enough. Research has argued that modern classification systems fail to capture other psychosocial variables prevalent in migraine such as DSM-5 (Cosci et al., 2020).

Shutdown dissociation and not psychoform dissociation predicted chronic migraine which can be considered a noteworthy finding, requiring further investigation. This is especially the case as it mediated seven predictor variables and chronicity and seven predictor variables and severe disability. Importantly, this indicates that these predisposing factors are related to increased chronicity if migraineurs engage in shutdown dissociation, which is a novel finding in the migraine field. Higher rates of childhood neglect and somatoform and psychoform dissociation have been documented in chronic headache samples (Arik et al., 2008; Yücel et al., 2002), but this research has grouped together multiple forms of neglect. Another study demonstrated significantly higher levels of emotional abuse and somatoform dissociation in migraine than in healthy controls, but did not investigate this finding further than between group analysis (Kucukgoncu et al., 2014).

The SHUT-D is argued to be distinct from other measures of dissociation such as DES-II in that it was constructed based on a theoretical model that includes the biological and the neural system and not based on clinical heuristic observations. This model therefore provides an opportunity for additional integrated biopsychosocial research into dissociation and migraine.

For instance, left-side migraineurs are identified as having predominant parasympathetic activation in response to pain compared to right-side migraineurs (Avnon et al., 2004). Given the role of the parasympathetic system in dissociation, future research could examine shutdown dissociation, the autonomic nervous system and migraine location.

Incorporating biopsychosocial constructs, such as shutdown dissociation, into migraine treatment offers new strategies in reducing the risk of chronification and disability in migraine. For instance, measuring ANS functioning through the vagus nerve, an important connection between body and brain could offer additional insight in assessment of stress, trauma and migraine pain (Porges & Dana, 2018; Yuan & Silberstein, 2016). Similarly, growing evidence concerning neurofeedback in PTSD samples has demonstrated changes in amygdala connectivity and emotion regulation regions of the brain (Nicholson et al., 2020b, 2020a). In a therapy setting this could include psychoeducation of possible physiological responses in shutdown, comparing sensory similarities between the trauma context and a therapeutic setting, promoting activation such as applied muscle tension and not relaxation to maintain arousal and prevent immobility, and importantly not terminating exposure to the trauma before integration with contextual cues such as time and location of danger (Hembree & Cahill, 2007; Schauer & Elbert, 2010; Schauer et al., 2011).

Limitations and considerations for future research

This research employed an online cross-sectional design and offers only a brief snapshot of a migraineur's experience. Recall bias using the retrospective CTQ, is therefore a probable source of bias arising from this design. Under- or over-reporting are also possible limitations associated with the CTQ owing to the sensitivity of this area. Furthermore, given this cross-sectional design these findings cannot demonstrate causality for the direct or indirect role of psychosocial factors on chronic migraine or severe disability. This is especially important given that the purported limitations in screening tools for chronic migraine (Potter et al., 2019) and the diagnostic boundary of chronic migraine being created by consensus rather than empirical investigation with fluctuations documented in participant criteria for chronic migraine (Buse et al., 2019; Caronna et al., 2020; Serrano et al., 2017). Not having access to migraine diagnoses could have impacted on analysis and interpretation of results. One important example of this is the possibility of symptoms relating to migraine with aura confounding the high rates of shutdown dissociation, predicting chronic migraine.

Undercoverage and self-selection bias are other important limitations to consider with the use of an online survey, given that they only capture data of those with internet access or adequate computer literacy and may not meet the

principles of probability sampling (Bethlehem, 2010; Couper, 2000; Wright, 2005). This bias may partially explain the proportionally higher rates of chronic and severely disabled migraine participants in this study given that these participants have a more active presence online for the management of migraine.

The limitations of this study point to the need for further research into psychosocial variables using prospective designs from multiple recruitment pathways including online and clinic or GP based pathways. Studying biopsychosocial risk factors for chronic migraine has been proposed to offer targets for further understanding of and intervention for this condition (Buse et al., 2019). Doing so could help stem the onset of chronic migraine progression or improve remission to episodic migraine (May & Schulte, 2016). However, research into psychological intervention is constrained by a lack of high-quality research and insufficient efficacy in improving the primary outcome of migraine frequency (Sharpe et al., 2019), a finding reminiscent of early pharmacological interventions in headache (Tfelt-Hansen et al., 2000). An important caveat to consider with psychosocial factors in this condition is that migraineurs may also not adhere to psychological interventions (Gewirtz & Minen, 2019; Minen et al., 2020), nor consider them a high priority compared to fast-acting medication (R. A. Nicholson et al., 2007). Continued research is ongoing (Klan et al., 2019; Mansueto et al., 2018), however, furthering this area requires systematic evaluation of interventions targeting modifiable risk factors in episodic migraine over sufficient time to discern whether they can adequately reduce progression to chronic migraine status (Buse et al., 2019).

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Appendix. Cut Off Thresholds for Outcome Variables in Binary Logistic Regression

Variable	Migraine Chronicity	Migraine Disability
	Cut Off Threshold	Cut Off Threshold
CTQ Emotional Abuse		
None-Minimal	5–8	5–8
Slight-Moderate	9–12	9–12
Moderate-Severe	13–15	13–15
Severe-Extreme	16–25	16–25
CTQ Physical Abuse		
None-Minimal	5–7	5–7
Slight-Moderate	8–9	8–9
Moderate-Severe	10–12	10–12
Severe-Extreme	13–25	13–25
CTQ Emotional Neglect		
None-Minimal	5–9	5–9
Slight-Moderate	10–14	10–14
Moderate-Severe	15–17	15–17
Severe-Extreme	18–25	18–25
CTQ Physical Neglect		
None-Minimal	5–7	5–7
Slight-Moderate	8–9	8–9
Moderate-Severe	10–12	10–12
Severe-Extreme	13–25	13–25
CTQ Sexual Abuse		
None-Minimal	5	5
Slight-Moderate	6–7	6–7
Moderate-Severe	8–12	8–12
Severe-Extreme	13–25	13–25
ECR-RS Anxiety	3.56	3.56
ECR-RS Avoidance	2.92	2.92
TAS20	51	51
DES-II	10.89 (ROC)	14.39 (ROC)
Shut D	7.5 (ROC)	8.36 (ROC)
APT	70	70
PHQ-8	10	10
GAD-7	10	10

CTQ = Childhood Trauma Questionnaire, ECR-RS = Experiences in Close Relationships-Relationship Structures, TAS-20 = Toronto Alexithymia Scale 20-item, DES-II = The Dissociative Experiences Scale-II, Shut D = The Shutdown Dissociation Scale, APT = The Affect Phobia Test, PHQ-8 = Patient Health Questionnaire-8, GAD-7 = General Anxiety Disorder-7

ROC = Score under receiver operating characteristic curve employed