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ORIGINAL ARTICLE

Anxiety, history of childhood adversity, and experiencing chronic pain in adulthood: A systematic literature review and meta-analysis

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Abstract

Background: When considering factors that may impact chronic pain experiences in adulthood, adverse childhood experiences (ACEs) and anxiety should be considered. The literature on the associations between these 3 variables remains unclear.

Objective: To summarize the existing literature on the relationship between ACEs and anxiety on chronic pain experience in adults, and examine the association between ACEs and anxiety.

Methods: A systematic literature review (SLR) and meta-analysis was used to examine adults (≥18) with a reported history of ACEs, self-reported and/or diagnosed anxiety, and chronic pain. The SLR included quality appraisal according to the Joanna Briggs Institute tool.

Results: The narrative summary indicated a significant association between ACEs, anxiety, and chronic pain experiences in adults. Of 52 selected studies, 79% reported a moderate–strong association. For ACE prevalence, the majority reported experiencing sexual abuse (50% [SD 16.01]), followed by physical abuse (46% [SD 20.7]). Other ACEs included emotional abuse (33% [SD 17.17]), emotional neglect (25% [SD 21.02]), and physical neglect (23% [SD 22.44]). Meta-analyses showed moderate associations between anxiety and chronic pain ($r = 0.30$; 95% CI = [0.14, 0.45], $p < 0.01$) and between ACEs and anxiety ($r = 0.26$; 95% CI = [0.15, 0.36], $p < 0.01$), and that participants who experienced ACEs are around twice as likely to present chronic pain during adulthood (OR = 1.99; 95% CI = [1.53, 2.60], $p < 0.01$).

Conclusion: The results of the SLR and meta-analysis indicated that ACEs and anxiety influence chronic pain experience in adults. Given the relationship between ACEs and anxiety, there would be value in exploring this as a potential mediator in future studies.

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Significance: There was an unmet need to summarize the existing literature on the relationship between ACEs and anxiety on chronic pain experience in adults and the association between ACEs and anxiety. The results of this systematic review and meta-analysis indicated that both ACEs and anxiety influenced chronic pain experience in adults and helped to inform the diverse literature on these potential relationships to date.

1 | INTRODUCTION

Historically, anxiety has had a wide variety of meanings and interpretations. Definitions have ranged from the anticipation of a future threat to the emotional response to a real or perceived imminent one (Crocq, 2015). The DSM-5 (DSM, 2013) adds nuance to this by focusing on the cognitive features of anxiety as "apprehensive expectation" (Crocq, 2015). Although anxiety has been considered biologically adaptive by promoting danger avoidance, an obvious discrepancy exists between mild, adaptive anxiety in everyday life and the distressing pathological anxiety requiring immediate intervention (Robinson et al., 2013). This difference is determined by professional or clinical assessment, with traumatic or tense experiences often being triggers for developing maladaptive anxiety.

During these types of anxiety-inducing experiences, the brain is in a heightened state of stress, which has long-lasting negative impacts (Bremner, 2006). Although existing research has focused on behaviour, emotional development, and mental and physical health after anxiety, research addressing a direct link between anxiety and experiencing chronic pain is limited. The long-term impacts of hyperarousal experienced in high anxiety states specifically and trauma history are not fully understood when considering pain. Studies have tended to focus on depression and post-traumatic stress disorder (PTSD) with pain (Morasco et al., 2013). One example that induces heightened, prolonged stress is adverse childhood experiences (ACEs). ACEs are childhood traumatic events, including experiencing violence, abuse, neglect, witnessing violence, having a family member attempt suicide or die, and aspects of home or community environments that undermine safety and stability (CDC, 2022). ACEs inhibit optimal development by altering gene expression, brain function, and even organ function (Merrick et al., 2019). ACEs also influence developing unhealthy coping strategies, which negatively affect behaviours, mental health, life opportunities, morbidity, and physical health such as chronic pain (Merrick et al., 2019).

In terms of economic burden, chronic pain has been a major factor affecting stress and anxiety in workers, and the costs of pain-related lost productivity ranged from $299 to $335 billion based on results from a large-scale survey using 2008 data in the United States (Sakamoto et al., 2019). In the United Kingdom, the Health and Safety Executive report in 2015 estimated considerable costs to the British economy due to stress at work, with £14.3 billion lost in 2013–2014 (Bhui et al., 2016). This makes the annual cost of chronic pain greater than non-communicable diseases (e.g., heart disease, some cancers, and diabetes), which are inaccurately considered to drive larger economic losses.

In a recent study examining underlying neural mechanisms associated with ACE history in American adults, empirical evidence suggested that early-life adversity alters the normative development of the amygdala. Results indicated that maltreatment, as a type of ACE, tends to predict a higher sensitivity to environmental threats and this leads to increased levels of anxiety. For maltreated individuals, neuroimaging research has demonstrated how hypervigilance to threatening stimuli may be a side effect of heightened amygdala activity (Kalia et al., 2020). In chronic pain populations, it has been shown that anxiety disorders are second only to depression as a psychological comorbidity. Clinical or pathological anxiety involves increased feelings of dread that interfere with standard functioning and may be mediating hypervigilance, potentially contributing to or exacerbating pain experiences (Woo, 2010). Additionally, a recent systematic review documented high levels of ACEs in adults with chronic pain and showed that ACEs impacted the form, presence, severity, and extent of chronic pain in adults (Nicolson et al., 2023). Several studies have also shown the involvement of neuroanatomical reorganization, neurotrophin and monoamine depletion, neuroinflammation, and endocannabinoid system changes to the general experience of pain after trauma (Brown et al., 2018). It is unclear what this link means clinically, but the variety of implications involved is important to consider for the development of chronic pain conditions. In addition, high concentrations of inflammatory markers have been described in PTSD, anxiety, panic disorder, and even a variety of phobias; however, results on a relationship between inflammation and anxiety-related symptoms are inconsistent (Michopoulos et al., 2017). Despite links between ACEs and chronic pain, the role of anxiety in this pathway, independent of a link with depression, remains unclear and under-investigated.

To enhance the understanding of this pathway, a critical first step is gaining a comprehensive overview of the current evidence on the associations between ACEs, anxiety, and chronic pain. To this end, the primary objective of this systematic review was to investigate the relationship between ACEs and anxiety on chronic pain experience in adults. This incorporated examining (1) the relationship between ACEs and chronic pain; (2) the relationship between anxiety and chronic pain; (3) the association between ACEs and anxiety; and (4) if possible, the associations between all three variables. While many individual studies have explored the relationship between ACEs and pain or ACEs and anxiety, no overarching review has summarized all of the evidence available. By summarizing the diverse evidence on these associations, this review sought to bridge the current gap by better understanding each of the relationships between these factors.

2 | METHODS

2.1 | Search strategy

For the systematic literature review (SLR), the search strategies focused on childhood adversity, trauma outcomes, comorbidities, chronic pain, ACEs, neurophysiology of anxiety, and neuroanatomical changes due to trauma. Chronic pain was defined by each individual article, with the standard assumption being pain lasting more than 3 months (see overview in Table 1 or each article-specific chronic pain measure in Table 2). The search was conducted in August 2021, and the publication range included the last 20 years to capture a meaningful span of the existing literature. Electronic databases searched included PubMed, MEDLINE, PsycInfo, and PsycArticles. The focus was on primary studies, in English, which investigated patients with a history of anxiety as well as papers exploring the outcomes of childhood trauma, stress, and chronic pain. The subject index terms primarily utilized in the search strategies included the following: adult; adult survivors of childhood adverse events; anxiety; anxiety disorders; child; child health; chronic pain; humans; mental disorders; mental health; pain; and risk factors. To allow for the variety of interpretation, cultural, and language differences of these terms globally, an extended variation of trauma, violence, abuse, and mental health terms was included to ensure as many studies as possible of relevance could be captured for review (Appendix A).

2.2 | Selection strategy

The screening process was conducted via Rayyan software (Ouzzani et al., 2016) between September 2021 and May 2022. After the initial title and abstract screening in January 2022, a 20% quality check of selection and conflict resolution were performed by a second reviewer (with the option to bring in a third reviewer for mediation as needed). The full texts of the included abstracts were subsequently screened by the first author for inclusion, with 20% quality check by a second reviewer (an undergraduate psychology dissertation student). Full texts behind a paywall were obtained and provided by the University of Stirling Library and Student Services. It was decided not to contact the corresponding authors to access further full texts due to the large number ($n = 91$) of initial studies already included in the review. All three co-authors were available to address screening decision conflicts, but the limited number that came up were resolved between reviewers. Progress through screening and selection was illustrated in a PRISMA diagram (see Figure 1). Data extraction was conducted by the first author and reviewed by all three co-authors.

2.3 | Eligibility criteria

Specific criteria were identified using the Population, Exposure, Controls, Outcomes, Setting, and Study designs (PECOS) criteria. Population was adults (age

TABLE 1 Systematic review factors of interest.

Factor	Range of outcomes as expressed across identified literature
ACEs	Childhood maltreatment; childhood trauma; stressful experiences in childhood; early-life adversity; physical abuse; sexual abuse; emotional abuse; verbal abuse; emotional or physical neglect; parental death or suicide; exposure to domestic violence; witnessing violence; parental incarceration; exposure to/witnessing addiction or drug abuse; parental divorce; lack of access to basic needs (going to doctor, food, etc.)
Anxiety	Self-reported; diagnosed
Chronic pain	Pain lasting more than 3 months; self-reported number of pain sites; chronic pain conditions (e.g. fibromyalgia, migraine, chronic urologic and/or pelvic pain, back pain, arthritis)

Abbreviation: ACEs, adverse childhood experiences.

TABLE 2 Characteristics of selected studies for narrative synthesis ($n = 52$).

Study ID[a]	Year	Instrument(s) to measure ACEs, pain, and/or anxiety	Mean age
Alhalal et al. (2018)	2015	Arabic version CTQ, CPG	41
Bayram et al. (2014)		CTQ, HAD, NPS	39.1
Brennenstuhl and Fuller-Thomson (2015)	2012	CSA	46.95
Brown et al. (2018)	Sep 2016–Nov 2016	CTQ, POLO, GADS	48.3
Coles et al. (2015)	1996	SF-36	30.6
Corsini-Munt et al. (2017)	2014–2015	CTQ, STAI-T	27.8
Craner and Lake (2021)	Jan 2018–May 2019	ACE, PROMIS-pain, PROMIS-anxiety, PCS, PSEQ	49.03
De Roa et al. (2018)	N/a	Visual analogue scale, CTQ, Holmes and Rahe Scale, HADS	N/a
Dennis et al. (2019)	Aug 2016–March 2018	The ACE questionnaire, PROMIS, WPI	43.3
Fowler et al. (2020)	2002	ACE scale, DSM-IV	54.5
Fuller-Thomson et al. (2010)	2005	CCHS	46
Fuller-Thomson et al. (2015)	2012	GAD, CSA	60
Generaal et al. (2016)	N/a	CPG questionnaire	44.7
Green et al. (2001)	March–August 1997	Drossman Physical–Sexual Abuse Questionnaire, Hopkins	46.4
Hart-Johnson and Green (2012)	n.m	DAQ. MPQ, PDI, PCPT, SF-36	34
Hellou et al. (2017)	Feb 2013–Sept 2015	CTQ, Patient Health Questionnaire-4	46.6
Hughes et al. (2016)	April–July 2013	SWEMWBS	43.5
Jones et al. (2009)	Mar-56	Biomedical survey	45
Kamiya et al. (2016)	Late 2009 and mid-2011	HADS-A, SCQ	60.4
Kascakova et al. (2020)	2016	CTQ	46.61
Kelly et al. (2011)	Aug 2006–June 2008	VAMSTA	40.3
Krantz et al. (2019)	April–Sept 2018	ACE, HADS-A, CCI, BRFSS	40

Type and prevalence of ACE (%)[b]	Pain measure or condition	Association between ACEs and chronic pain (weak, moderate, strong)	Association between anxiety and chronic pain (weak, moderate, strong)
Emotional abuse: 9.18, physical abuse: 7.48, sexual abuse: 6.85	Chronic pain severity	Strong	Weak
Emotional abuse: 40.4, sexual abuse: 5.3, physical abuse: 26.2	Fibromyalgia, rheumatoid arthritis	Strong	Strong
Parental domestic violence: 15.7, physical abuse: 52.3, sexual abuse (touching only): 8.4, sexual abuse (forced sexual activity): 11.7	Migraine	Strong	n.m
Physical neglect: 22.4, emotional neglect: 13.1, Bullying at school: 10.8, multiple maltreatment: 31.2	Levels of pain	Strong	Moderate
CSA	Bodily pain	Strong	n.m
n.m	Vestibulodynia	Strong	Strong
1 ACE: 19.7, 2ACE: 12.6, 3 ACE: 11.9	Chronic pain, fibromyalgia, back pain, headache/migraine	Strong	Weak
Emotional neglect: 56.8, physical neglect: 9.1, emotional abuse: 20.5, physical abuse: 25, sexual abuse 8.8	Fibromyalgia, migraine	Strong	Strong
Mental illness: 54, Divorce: 50, emotional abuse: 47.9, emotional neglect: 44.8, household substance abuse: 40.2, sexual abuse: 34.7, physical abuse: 30.1, physical neglect: 16.6%, household member in prison: 8.0%	Chronic pain	Strong	Strong
Parental death: 15, sexual abuse: 1.5	Chronic neck or back pain, arthritis or rheumatism, frequent or severe headaches, or any other chronic pain over the last 12 months	Strong	Strong
Parental unemployment: 12.5, divorce: 10.1, parental addiction: 11.5	Migraine	Strong	n.m
n.m	Chronic pain, inflammatory bowel diseases (IBDs)	Strong	Strong
Early and recent life stress (100)	Chronic multi-site musculoskeletal pain	Strong	weak
Physical abuse: 41, sexual abuse: 59, physical and sexual abuse: 41	Pain (e.g., pelvic, back, and head pain)	Strong	Strong
Physical or sexual abuse: 67	Four pain subscales: sensory, affective, evaluative, and miscellaneous	Weak	n.m.
Emotional abuse: 12, physical abuse: 9.3, sexual abuse: 9.3, emotional neglect: 16, physical neglect: 8	Fibromyalgia, rheumatoid arthritis	Strong	Strong
n.m		Weak	n.m
Ever in institutional care: 23.3, Death of parent: 36.3, Family difficulties: 17.2	Chronic widespread pain	Weak	n.m
Parental experienced drug and drink: 22, physical abuse parent: 17.5, physical abuse other than parent: 40	Chronic pain	Strong	Moderate
Emotional abuse: 23.1, physical: 7.7, sexual: 9.9, emotional neglect: 33, physical neglect: 54.9	Chronic pain-related condition (migraine, back pain, arthritis, pelvic pain, or pain of unclear origin)	Strong	Strong
Childhood abuse: 60.4	Chronic pain	Strong	n.m
Physical abuse: 43, sexual abuse: 55, emotional: 62, domestic violence: 35	Chronic pelvic pain, fibromyalgia, other pain condition, IC, IBS	Strong	Strong

(Continues)

TABLE 2 (Continued)

Study ID[a]	Year	Instrument(s) to measure ACEs, pain, and/or anxiety	Mean age
Lai et al. (2016)	Oct 2012–July 2014	CTES, RTES, HADS-A, PROMIS	53.4
Lee et al. (2009)	n.m	WMH–CIDI	46.2
Leisner et al. (2014)	n.m	CTQ, MPI-D, SES, HADS	57.5
Määttä et al. (2019)	Jan 2015–Dec 2016	The Trauma and Distress Scale, BAI, BDI	54
Macedo et al. (2019)	n.m	CTQ, BPI	24.82
McCall-Hosenfeld et al. (2014)	2005–2007	Health Home Questionnaire, PHQ	47
Mehta et al. (2017)	n.m	ASI, PI-SF, DASS-21, PCS, SPAHQ	45.4
Naliboff et al. (2015)	n.m	GUPI, HADS, BPI	46.8
Nicol et al. (2016)	Nov 2010–Feb 2014	BPI, HADS. PROMIS	45.47
Nicolson et al. (2010)	May 2002–March 2004	CTQ-sf	53.5
Noteboom et al. (2021)	n.m	CTQ-SF, NEMESIS-2	42.6
Nygaard et al. (2019)	March 2015–Nov 2016	NRS, HSCL	38
Ottenhoff et al. (2019)	Nov 7–Nov 20, 2017	ACE scale, SHAI-5, PCS-4	51
Piontek et al. (2021)	June 2012–July 2017	ACE Scale, MPQ, GAD	47.92
Poli-Neto et al. (2018)	Feb 2012–Feb 2013	CTQ, HADS, VAS	38
Sachs-Ericsson et al. (2017)	1990	NCS	43.03
Schrepf et al. (2018)	n.m	CTES, HADS	43

Type and prevalence of ACE (%)[b]	Pain measure or condition	Association between ACEs and chronic pain (weak, moderate, strong)	Association between anxiety and chronic pain (weak, moderate, strong)
Death of close member: 51 divorces: 33.3, sexual experience: 29.4, violence: 23.5, injuries: 27.4, others: 35.5	Chronic bladder pain and/or non-urologic pain	Strong	Strong
Any childhood family advertise: 43.2	Frequent and/or severe headaches	Strong	Moderate
Abuse: 40.8, physical, emotional and sexual FME: 2.91, physical FME: 21.4, emotional FME: 27.2, sexual FME: 19.4	Chronic low back pain, sensory pain perception	Strong	n.m
Emotional neglect: 75, physical neglect: 63, emotional abuse: 35, physical abuse: 25, sexual abuse 10	Chronic neuropathic pain	Strong	Moderate
Emotional abuse: 54.5, physical abuse: 40.9, sexual abuse: 36.6, physical neglect: 45.5	Chronic pain	Strong	n.m
Sexual trauma: 49, IPV Victimization: 57, any interpersonal trauma: 73	Chronic pain	Weak	n.m.
Sexual abuse: (childhood: 29.5, adulthood: 39.8), physical abuse (childhood: 66.4, adulthood: 56.1)	Chronic pain, pain-related disability	Strong	n.m
n.m	Urologic chronic pelvic pain syndromes	n.m	n.m
History of childhood abuse: 15.25	Chronic pain: spine pain (including cervical, thoracic, and lumbar spine); headache and facial pain; joint pain (e.g. shoulders, elbows, hip, knees); extremity pain (e.g. arms, legs, feet, hands); neuropathic pain; abdominal and genitourinary pain; Widespread musculoskeletal pain; cancer pain; Miscellaneous pain	Strong	Strong
Physical abuse: 8.3, sexual abuse: 8.9, emotional neglect: 10.7, emotional abuse: 11.4, physical neglect: 7.1	Chronic pain conditions (combined fibromyalgia and osteoarthritis or osteoarthritis only)	n.m	n.m
Emotional neglect: 19.8, sexual trauma: 7.6, physical trauma: 7.8	Adult chronic physical disorders (migraine, musculoskeletal, etc.)	No association	Strong
Physical, psychological, and sexual abuse: 39	Chronic pain (back, headache, etc.), chronic pelvic pain	n.m	n.m
Among cases: 24	Chronic pain intensity	No association	Strong
Emotional abuse: 19.65, Physical abuse: 13.10, sexual abuse: 8.73, emotional neglect: 18.34, physical neglect: 4.7, divorce: 20.09, mother treated violently: 6.99, substance abuse in household: 12.66, mental illness: 19.65, incarcerated household: 1.31	Chronic pelvic pain syndrome	Strong	Strong
Childhood maltreatment: 77.9, emotional neglect: 58.4, multiple maltreatment: 18.2, physical neglect: 58.4, emotional abuse: 48 physical abuses: 45.4, sexual abuse: 29.9	Chronic pelvic pain	Moderate	Moderate
Early parental loss: 21.8, verbal abuse: 9.3, physical abuse: 2.9	Chronic pain conditions (arthritis/ rheumatism, chronic back or neck problems, severe headaches, other)	Strong	Strong
Death of family member: 50, Divorce: 30, Traumatic sexual experience: 20, victim of violence: 15, injured: 20, other trauma: 34	Urologic chronic pelvic pain syndrome	Strong	Weak

(Continues)

TABLE 2 (Continued)

Study ID[a]	Year	Instrument(s) to measure ACEs, pain, and/or anxiety	Mean age
Scott et al. (2011)	2001–2004	WMH–CIDI	n.m
Sprang et al. (2020)	2006–2014	KWHR	36.5
Tietjen (2009c)	Feb 2006–June 2008	CTQ, HIT-6, BAI	41
Tietjen et al. (2009)	Feb 2006–June 2008	CTQ, PHQ, BAI	41
Tietjen et al. (2009b)	Feb 2006–June 2008	CTQ, PHQ, BAI	41.05
Tietjen et al. (2015)	2005–2009	CTQ, Patient Health Questionnaire,2	54.4
Tietjen et al. (2017)	May–Dec 1995	Self-reported clinical diagnoses of depression and anxiety	29.5
von Korff et al. (2009)	n.m	Conflict Tactics Scale	45.5
Williams et al. (2019)	n.m	ACE, GAD-7, SF-12	n.m
Yeung et al. (2016)	n.m	CTQ, MHI	51.83
You et al. (2019)	Sep 2012–April 2015	ETISR questionnaire	18.8
Yücel et al. (2002)	n.m	DES, SDQ, Childhood abuse and neglect questionnaire	n.m
Zlotnick et al. (2017)	n.m	ACE-IQ, STAI	43.21

Abbreviations: ACE questionnaire, Adverse Childhood Experiences Questionnaire; BAI, Beck Anxiety Inventory; BDI, Beck Depression Inventory; BPI, Brief Pain Inventory; CPG, Chronic Pain Grade; CTES, The Childhood Traumatic Events Scale; CTQ-sf, Childhood Trauma Questionnaire—short form; DAQ, Drossman Abuse Questionnaire; DES, Dissociative Experiences Scale; ETISR, Early Traumatic Inventory Self-Report; GAD, Generalized Anxiety Disorder Scale; GUPI, Genitourinary Pain Index; HADS, Hospital Anxiety and Depression Scale; HIT-6, Headache Impact Test; HSCL, Hopkins Symptom Checklist; KWHR, The Kentucky Women's Health Registry; MPQ, McGill Pain Questionnaire; MHI, Mental Health Inventory—Anxiety subscale; MPI-D, Multidimensional Pain Questionnaire; N m, not mentioned; NPS, numeric pain scale; PCPT, Posttraumatic Chronic Pain Test; PCS, Pain Catastrophizing Scale—short form; PHQ, Patient Health Questionnaire; POLO, Polytrauma Outcome; NRS, Numerical Rating Scale; RTES, Recent Traumatic Events Scale; SDQ, Somatoform Dissociation Questionnaire; SES, pain perception scale; SHAI-5, Short Health Anxiety Inventory; SPAHQ, Sexual–Physical Abuse History Questionnaire; STAI, Spielberger's State–Trait Anxiety Inventor; STAI-T, State–Trait Anxiety Inventory; SWEMEBS, Short Warwick–Edinburgh Mental Well-being Scale; VAMSTA, Veterans Affairs Military Stress Treatment Assessment; VAS, visual analogue scale; WMH–CIDI, World Mental Health Composite International Diagnostic Interview.

[a]Bolded studies indicate they looked at all 3 outcomes of interest according to the methodology (but not all reported results in full).

[b]Trauma includes early-life adversity (ELA), adverse childhood events (ACEs), childhood trauma, early-life stress, etc., as applicable to any trauma or abuse prior to adulthood.

18 years or over) with chronic pain and/or anxiety, self-reported and/or diagnosed. Exposure was adverse childhood experiences/early-life adversities/early-life or childhood trauma. Controls were not present in all studies but where present incorporated those without adverse childhood experiences who had chronic pain and anxiety. Outcome measures were presence of chronic pain and anxiety. Study designs included observational, correlational, cross-sectional, interventional, and longitudinal studies. Exclusion criteria were less than 18 years of age with no anxiety and/or no chronic pain and no childhood adversity.

Type and prevalence of ACE (%)[b]	Pain measure or condition	Association between ACEs and chronic pain (weak, moderate, strong)	Association between anxiety and chronic pain (weak, moderate, strong)
Physical conditions (hazard ratios from 1.44–2.19)	Arthritis, chronic spinal pain, chronic headache	Strong	Strong
Physical abuse: 8.7, sexual abuse: 3.2, physical and sexual abuse: 4.7, Intimate partner violence: 51	Chronic pain	Strong	n.m
Emotional neglect: 38, physical neglect: 22, emotional abuse: 38, physical abuse: 21, sexual abuse: 25	Migraine or chronic headache	Strong	Strong
Emotional neglect: 38, physical neglect: 22, emotional abuse: 38, physical abuse: 21, sexual abuse: 25	Migraine, chronic pain conditions (IBS, fibromyalgia, interstitial cystitis, arthritis, endometriosis, uterine fibroids	Strong	Strong
Emotional neglect: 38, physical neglect: 22, emotional abuse: 38, physical abuse: 21, sexual abuse: 25	Migraine	Strong	Strong
Emotional neglect: 24.5, emotional abuse: 22.5, sexual abuse: 17.7	Migraine, episodic tension-type headache	Strong	Strong
Physical abuse: 22.4, emotional: 57.8, sexual abuse: 8.4	Migraine	Strong	Weak
Death of parent: 12.8, parental divorce: 9.8, physical abuse: 9.6, family violence: 9.4	Chronic pain condition: arthritis	Strong	n.m
n.m	Pain level	Weak	Moderate
n.m	Fibromyalgia, daily pain level	Strong	No association
General: 78, physical: 73, emotional: 44, sexual: 20	Chronic pain, chronic back pain, chronic headache, dysmenorrhea	Strong	Weak
History of abuse: 9.58, history of neglect: 11.47	Chronic pain: headache, low back	Weak	n.m
Physical abuse: 53.3, alcohol abuse: 60, jailed person: 41.4, depressed person: 46.7, witnessed violence: 46.7, divorced: 13.3, emotional neglect: 10, physical neglect: 6.7	Pain level	Strong	Strong

2.4 | Critical appraisal

Several study appraisal and quality tools were reviewed for this study, and the main three of relevance were the Joanna Briggs Institute (JBI) tool (JBI, 2020), the National Institutes of Health tool (NHLBI NIH, 2021), and the Critical Appraisal Skills Programme tool (CASP, 2022). The JBI—an independent, international, not-for-profit researching and development organization that develops many critical appraisal checklists involving the feasibility, appropriateness, meaningfulness, and effectiveness of healthcare interventions—was selected for use in this review (Aromataris & Munn, 2020). The variety of tools to choose from is diverse, but the applicable range of study types captured by the JBI critical appraisal checklist was the widest and helped in making this selection. The full JBI checklist can be reviewed in Appendix B, along with a table comparison of each quality appraisal tool originally assessed for feasibility.

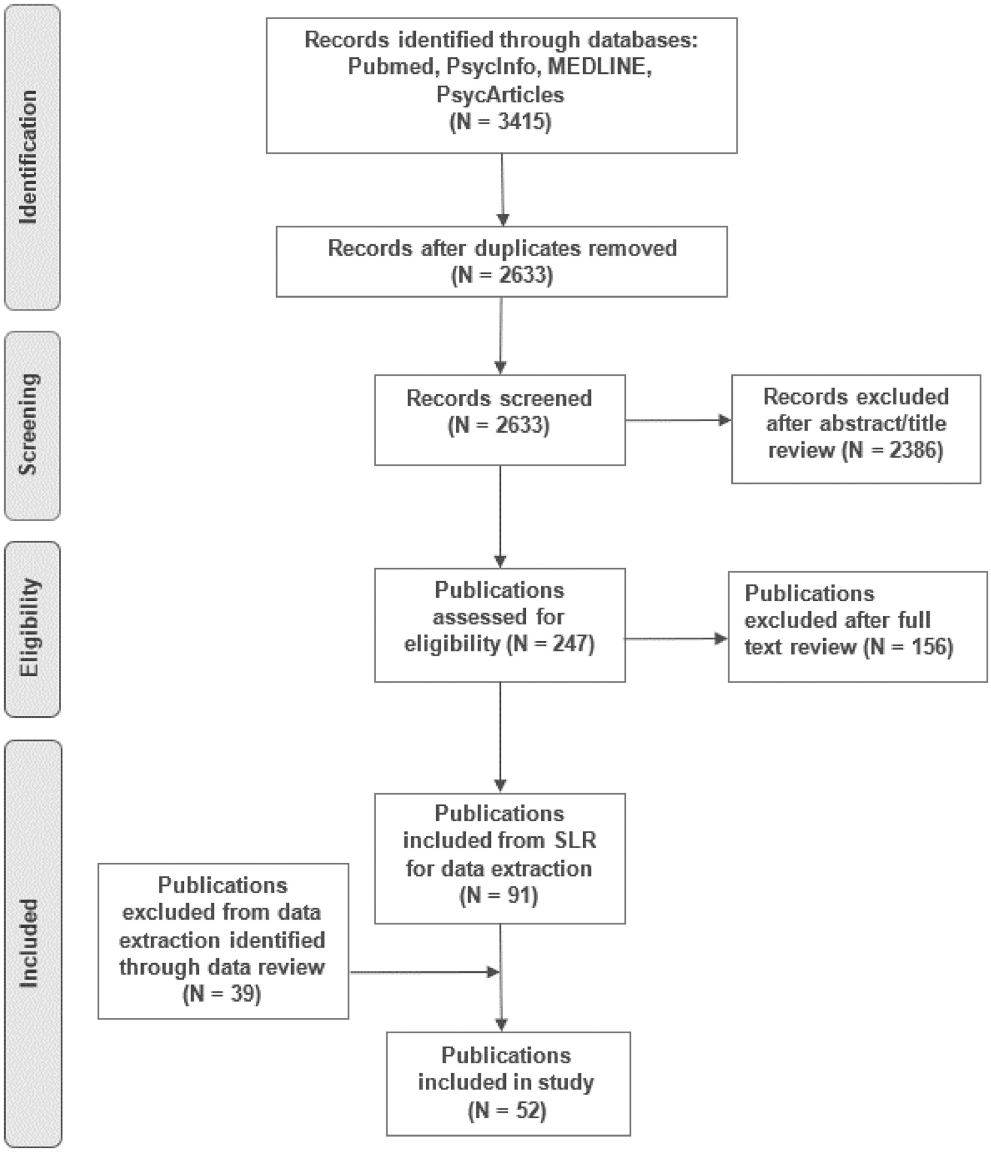

FIGURE 1 Study identification.

2.5 | Data extraction

Extraction was completed by the first author. Primary outcomes included chronic pain (both generally reported and/or defined conditions), childhood trauma history, and self-reported or diagnosed anxiety. Differences in sex were considered, if applicable depending on data, to highlight how rates of reported ACEs, anxiety rates, and pain outcomes might differ. For the extraction table, the following were examined: author information, year of survey or study, instrument to measure ACEs, participant age (mean), age at the ACEs (year), type and prevalence of ACE (%), association between ACEs and chronic pain (weak, moderate, strong), and association between anxiety and chronic pain (weak, moderate, strong). Chronic pain was not limited to a specific condition and could be reported generally or as a commonly recognized chronic pain condition as noted in Table 1.

Where available, information on pain intensity was also extracted as assessed by either self-report or records of the number of pain sites or chronic pain conditions. For ACEs, terms such as childhood maltreatment, childhood trauma, stressful experiences in childhood, early-life adversity, childhood adversities, and childhood psychosocial stressors were all considered as adverse childhood events. This review used the term ACEs, which links either directly to main types of childhood trauma (physical, sexual, emotional abuse, and neglect) or in combination with indirect types of ACEs (such as parental death or exposure to domestic violence). In this review, direct ACE definitions were aligned with the terminology of the World Health Organization International Society for Prevention of Child Abuse and Neglect (WHO 2006). The range of outcomes relevant for each factor is summarized in Table 1. To align with

the diversity in the literature and by country, pain and ACE measures were kept as broad as possible.

2.6 | Data analysis: Narrative synthesis

A narrative synthesis of findings and stratified results based on the type of persistent pain disorders and direct and indirect ACE exposures was conducted. Results from the studies were summarized and tabulated according to the variables listed above and discussed in narrative form.

For article appraisal and data extraction post the JBI quality check, a qualitative description of the association and the strength of the reported association (strong, moderate, weak) were assigned. These were based on the article's characterization of results per the abstract, results, and discussion section, as "strong" or "weak." Strong or weak was further justified by the statistical significance ($p < 0.05$) of the provided results or the effect size, depending on data availability in each study and the score of the respective study questionnaire scale, which was used to measure ACEs, anxiety, chronic pain, etc. Weak associations and those without enough data to make a conclusion were still included and reported to avoid bias in the results reported. Rather than relying on visual means of determining publication bias (e.g., funnel plot), which can overlook other sources of bias typically present in meta-analysis, such as heterogeneity, we have instead transparently reported the heterogeneity for all analyses conducted.

2.7 | Data analysis: Meta-analysis

Anxiety and a history of childhood adversity may influence chronic pain experiences. Meta-analyses were conducted using R statistical software (R Core Team, 2021) to investigate the size of any associations between types of ACE, anxiety, and/or chronic pain. After considering multiple approaches to the available data and reported associations, it made sense to define three types of different relationships for conducting the meta-analyses: anxiety and chronic pain; ACEs and chronic pain; and ACEs and anxiety. This was because these were the patterns of associations most commonly available in the selected studies.

This involved pooling correlations (using the correlation coefficient and sample size for each study), or using a binary classification of participants using one variable, and comparing means reported for the other variables. This approach was substituted with an odds ratio (OR) analysis when the scales used across studies were too different to be comparable; however, it may not be possible in all cases to classify the study participants. The extraction tables of the meta-analyses conducted are included in Appendix C. As even two studies are considered sufficient to perform a meta-analysis, provided that the two studies can be meaningfully pooled and provided their results are sufficiently "similar" (Ryan, 2016), there was no minimum study number set for conducting analyses.

An important limitation for the analyses was the wide variety of ACEs and chronic pain manifestations, resulting in variation seen in the methods, populations, and theoretical perspectives of the studies. Consequently, even if efforts were made to make the analysis as inclusive as possible, not every study could be included in the analysis for each association. Additionally, it should be noted that some studies are included several times; this is the consequence of those studies not reporting overall measurements or categories of either ACEs or chronic pain. Whenever possible, the separate measures were manually summarized to produce effects more in line with the rest of the studies; unfortunately, this was not always feasible. Hence, in studies where several categories of these variables were reported separately, each subcategory was included as a separate effect size in the meta-analysis.

2.8 | Data protection

Databases from the CDC are protected by Public Law 107-174 (No FEAR Act). All data relevant to this review were stored on a password-protected laptop that is locked up when not in use and was only accessible to the lead author. No personal identifiers were present in the data used.

3 | RESULTS

3.1 | Systematic searches

A total of 3415 articles were identified from the searches, and 519 were deleted due to being duplicates. A total of 91 articles were initially identified for extraction after reaching consensus with the secondary reviewer. Eight discrepancies between reviewers were identified at this stage, but consensus was agreed in discussion. After careful review of the available data in each and their feasibility for the analyses, a final total of 52 studies were selected for inclusion in this study based on the quality appraised via the JBI checklist (full table in Appendix B). There were no discrepancies that required an outside mediator, so the consensus ultimately came to 100%. The PRISMA diagram of the systematic review article selection is displayed in Figure 1.

3.2 | Narrative synthesis

Gender and ethnicity were not captured systematically across all studies; however, the majority of studies did report age or mean age. Based on the selected studies which reported age ($n = 48$), the mean participant age was 44.1 years (SD = 8.52) and ranged from 19 to 60 years, with most participants in their forties. For the measurement tools, the childhood trauma questionnaire (CTQ) was the most commonly used (18/52 or 35% of studies). For the selected outcomes to capture pain in adults, general or undefined chronic pain was most commonly measured in 59.6% of studies, followed by migraine or headache in 21.2%, back pain in 17.3%, arthritis in 17.3%, fibromyalgia in 15.4%, and pelvic pain in 15.4% of studies. The characteristics of all included studies are compiled in Table 2.

An analysis of the characteristics of reported abuse and prevalence is displayed in Figure 2. Of the 52 studies, the majority (50%, SD 16.01) reported participants had experienced sexual abuse, violence, or trauma in childhood; prevalence was 20.8% among these participants. Physical abuse was reported in 46.2% (SD 20.68) of selected studies, with an average prevalence of 27% reported by participants. For emotional abuse, 33.4% (SD 17.17) of studies, with an average prevalence of 32.6%, were reported by participants. Emotional neglect was reported in 25% (SD 21.02) of selected studies, with an average prevalence of 32.2%. Physical neglect was measured in 23.1% (SD 22.44) of selected studies, with an average prevalence of 26.5% reported by participants.

Witnessing violence against others at home (including parental domestic violence) experienced in childhood was reported in 13.5% of selected studies, with an average prevalence of 38.6% reported by these participants. Death of a parent or family member experienced in childhood was measured in 11.5% (SD 17.09) of selected studies, with an average prevalence of 31.2% reported by participants. Addiction or substance abuse by parent/family was measured in 9.6% of selected studies, with an average prevalence of 29.3% reported by participants.

A qualitative description of any associations between ACEs, anxiety, and chronic pain, and the strength of the reported association (strong, moderate, weak), was assigned based on the considerations described in Section 2. Of the selected studies, 41 (78.9%) had a moderate–strong association between ACEs and chronic pain. Eight studies had weak or no association (15.4%), and three did not have enough information to conclude or the study focus did not mention an association (5.8%).

Among the studies that associated anxiety and chronic pain without childhood adversity, nine had either a weak association or no association (17.3%), six had a moderate association (11.5%), and 22 had a strong association between anxiety and chronic pain (42.3%). The remainder did not have enough information to draw conclusions, or the study focus did not mention an association (28.9%).

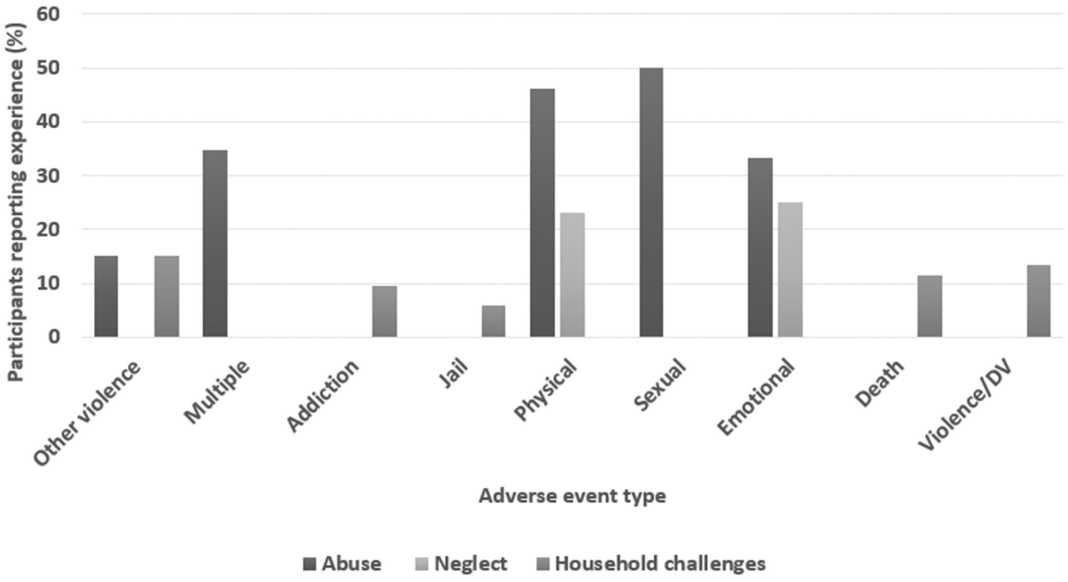

FIGURE 2 Early-life adversity experiences reported by participants (%). DV, domestic violence.

3.3 | Meta-analysis

The meta-analysis assessed the different relationships between ACEs, anxiety, and their influence and/or relationship with chronic pain, across several studies. As mentioned above, some studies were included more than once, but whenever it was possible, the separated measures were manually summarized to produce effects more in line with the rest of the studies and reduce the lack of independence between effect sizes in the meta-analysis. In studies where several categories of these variables were reported separately, each subcategory was included as a separate effect size in the meta-analysis.

3.4 | Association between ACEs and pain

The first meta-analysis (Figure 3) explored the ORs influencing chronic pain (or a pain condition) from presence/absence of ACEs. A total of 25 subsamples from 11 studies were included (Brennenstuhl & Fuller-Thomson, 2015; Coles et al., 2015; Craner & Lake, 2021; Fowler et al., 2020; Generaal et al., 2016; Kascakova et al., 2020; Krantz et al., 2019; McCall-Hosenfield et al., 2014; Sprang et al., 2020; Tietjen et al., 2009, 2016), resulting in an overall effect of OR = 1.99 (95% CI = [1.53, 2.60], $p < 0.01$). This indicated that participants who experienced ACEs were almost twice as likely to present chronic pain during adulthood. It should be noted that this analysis presented the largest between-study heterogeneity ($I^2 = 93\%$, $p < 0.01$), reflecting the wide variety of pain conditions included across studies.

Additionally, it was possible to conduct a correlation between the index of ACEs as reported by different scales and the intensity of chronic pain observed in patients. Pain intensity was measured either by self-report or by records of the number of pain sites or chronic pain conditions.

A total of 15 different correlations were extracted from 13 studies (Alhalal et al., 2018; Brown et al., 2018;

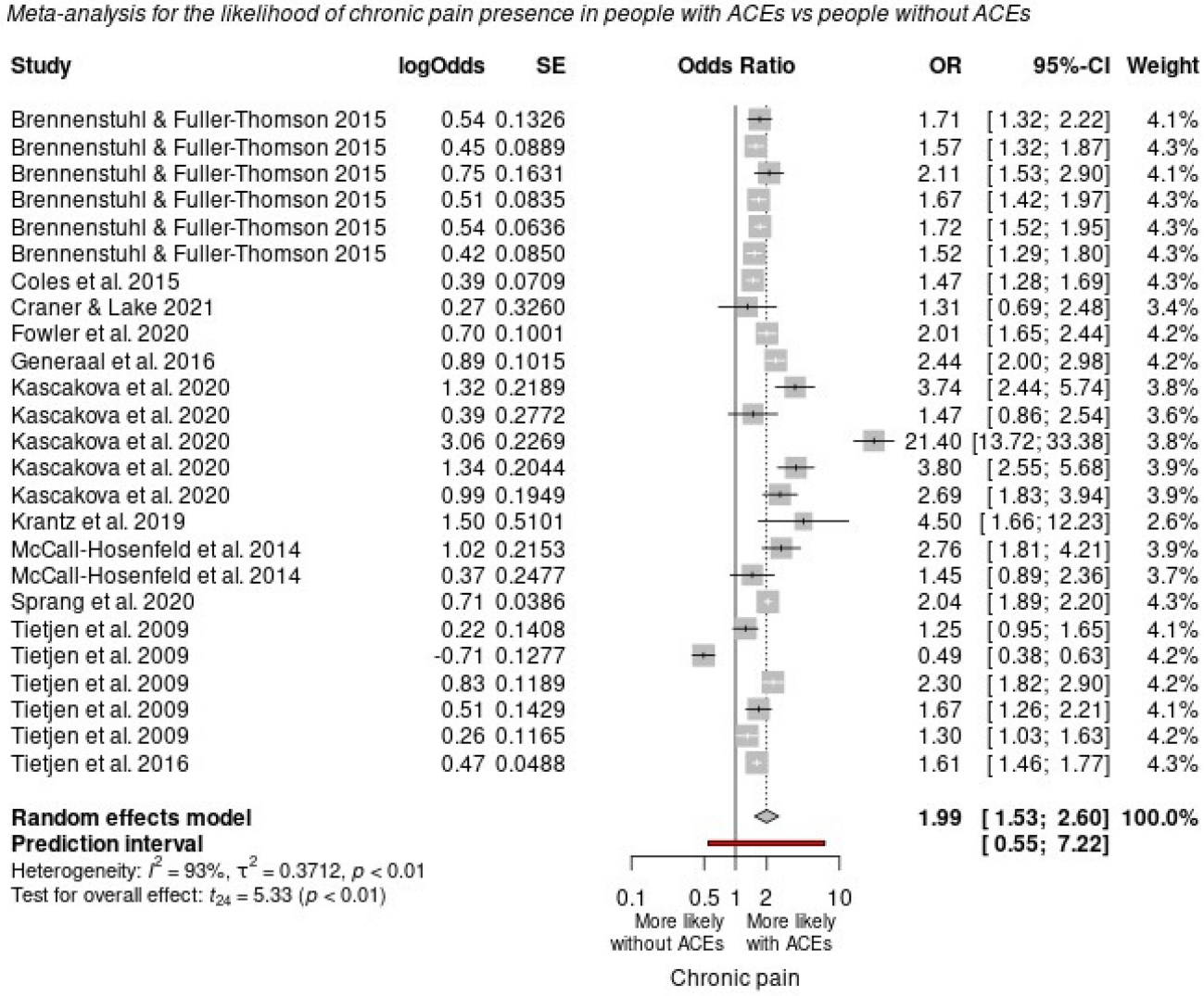

FIGURE 3 Likelihood of chronic pain presence in patients with ACEs compared to patients without ACEs. ACE, adverse childhood event; CI, confidence interval; OR, odds ratio; SE, standard error.

Corsini-Munt et al., 2017; Dennis et al., 2019; Kelly et al., 2011; Lai et al., 2016; Mehta et al., 2017; Ottenhoff et al., 2019; Piontek et al., 2021; Poli-Neto et al., 2018; Schrepf et al., 2018; Tietjen et al., 2009; Yeung et al., 2016), producing an overall correlation of $r = 0.17$ (95% CI = [0.11, 0.23], $p < 0.001$). This indicated there was a small but significant positive association between the index of ACEs and the intensity of chronic pain conditions in adulthood (Figure 4), such that the experience of more ACEs was related to greater pain intensity. The meta-analysis had a large between-study heterogeneity ($I^2 = 77\%$, $p < 0.01$).

3.5 | Association between anxiety and pain

In assessing the association between anxiety and chronic pain, an OR meta-analysis was not possible using the available studies. However, a correlation meta-analysis was still achieved. As with the previous relationship, chronic pain intensity was measured using either self-reports of pain intensity or the number of chronic pain conditions/pain sites reported. Anxiety, however, was measured using several standardized scales, including the HADS, GADS, and STAI.

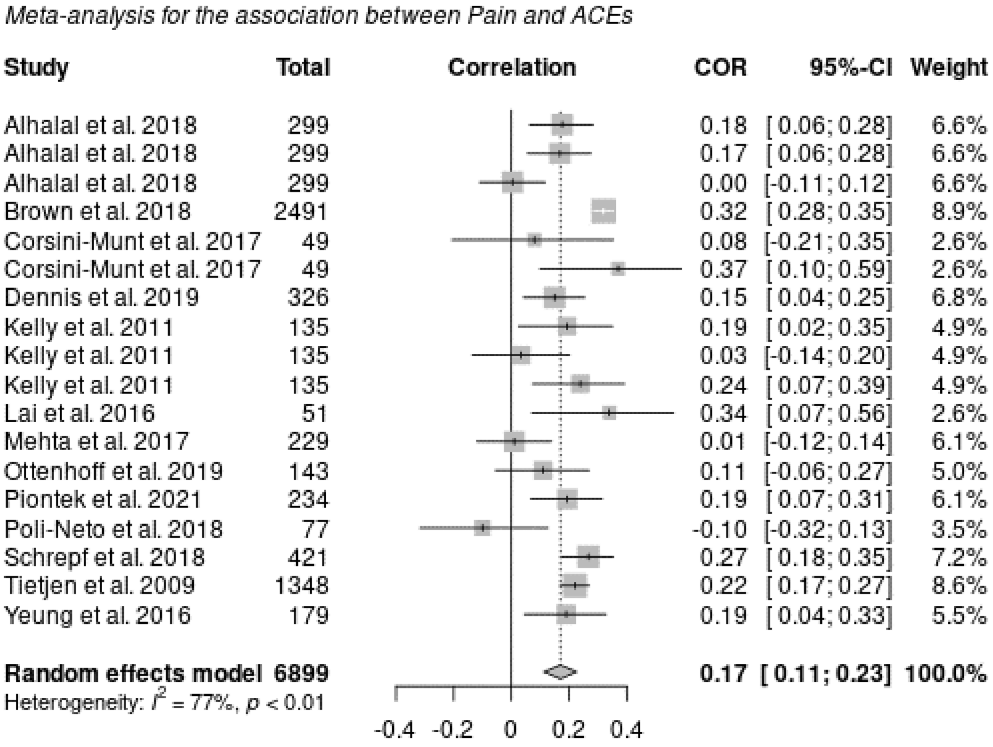

FIGURE 4 Association between ACEs and pain. ACE, adverse childhood event; CI, confidence interval; COR, correlation.

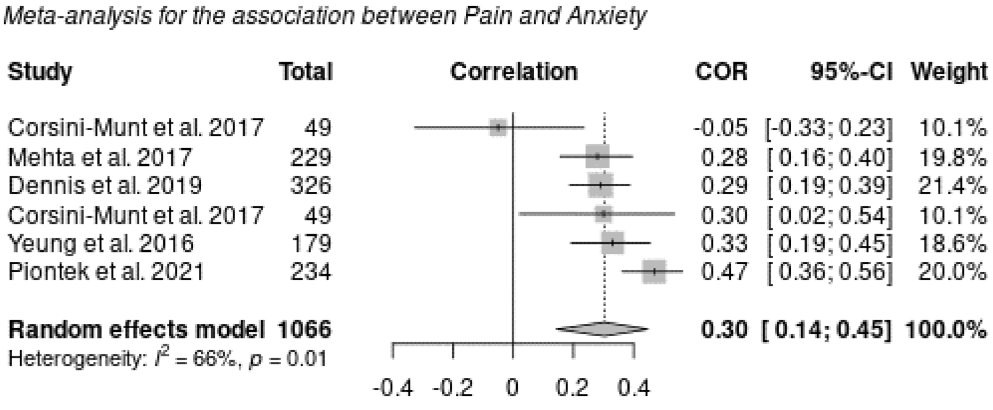

FIGURE 5 Association between anxiety and pain. CI, confidence interval; COR, correlation.

As displayed in Figure 5, six different correlations were extracted from five studies (Corsini-Munt et al., 2017; Dennis et al., 2019; Mehta et al., 2017; Piontek et al., 2021; Yeung et al., 2016), producing an overall correlation of $r = 0.30$ (95% CI = [0.14, 0.45], $p < 0.01$). This indicated a significant moderate positive association between anxiety and chronic pain indices, such that higher anxiety symptomatology was associated with higher pain intensity. The analysis also had a moderate between-study heterogeneity ($I^2 = 66\%$, $p = 0.01$).

3.6 | Association between ACEs and anxiety

A correlation meta-analysis exploring the relationship between ACEs and anxiety was conducted. As stated previously, ACEs were measured using indices from scales such as the CTQ and the ACE scale, while anxiety was most often measured using common clinical instruments. As shown in Figure 6, 8 correlations across 8 studies were extracted (Corsini-Munt et al., 2017; Dennis et al., 2019; Lai et al., 2016; Mehta et al., 2017; Piontek et al., 2021; Poli-Neto et al., 2018; Schrepf et al., 2018; Yeung et al., 2016), producing an overall correlation of $r = 0.26$ (95% CI = [0.15, 0.36], $p < 0.01$), indicating a significant positive moderate association between ACEs and anxiety, such that greater frequency of ACEs was related to greater anxiety symptoms. This analysis had a moderate between-study heterogeneity ($I^2 = 59\%$, $p = 0.02$).

4 | DISCUSSION

The results of this systematic review indicated that there was indeed substantial evidence available suggesting an association between childhood adversities and anxiety, and/or chronic pain experiences in adults, as well as associations between anxiety and pain. The meta-analyses further substantiated these relationships. There was an increased risk of chronic pain among those with ACEs and a small association between ACEs and chronic pain intensity. There were also moderate-sized significant associations between anxiety and chronic pain, as well as between ACEs and anxiety.

When examining the various types of adversity, results of the present narrative synthesis contrasted somewhat with past research in that sexual abuse was frequently reported on. For example, the CDC collection of ACE data as a part of the Behavioural Risk Factor Surveillance Survey (BRFSS) indicated that sexual abuse was the least commonly reported ACE (Giano et al., 2020). This could be explained by variations in the ACE type studied, variations in the study sample characteristics, or simply variations in the ACE definitions. In one report, for example, the prevalence of reported child sexual abuse ranged from 7% to 36% for women and 3%–29% for men, but then the WHO concluded 12% of children were sexually abused in 2015 (Broekhof et al., 2022). Additionally, the nature of ACE reporting indicates a shift to include more measures on not only physical and emotional abuse, but also neglect categories. This may provide valuable insight into any underlying changes associated with neglect and how that may overlap with the neurophysiological basis of anxiety as well, particularly in the context of adults with chronic pain that seems resistant to standard models of treatment. Furthermore, some research in this area has focused on the specific type or number of ACEs. However, recent research by Broekhof et al. (2022) revealed a high amount of overlap between three ACE sub-types and individual ACEs, indicating that perhaps ACEs should be assessed as a combined group rather than individually.

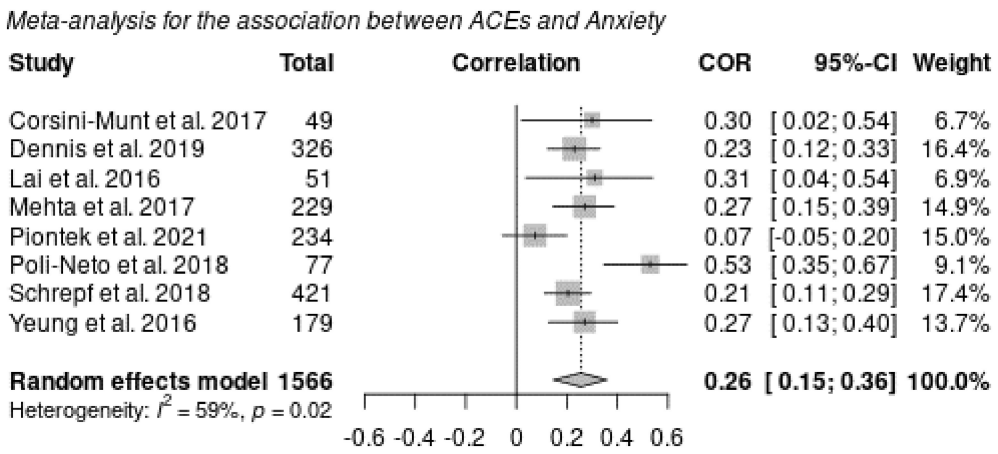

FIGURE 6 Association between ACEs and anxiety. ACE, adverse childhood event; CI, confidence interval; COR, correlation.

4.1 | ACEs and pain

The results of the meta-analysis revealed that participants who experienced an ACE were almost twice as likely to present chronic pain during adulthood. Although ACEs and the intensity of chronic pain were significantly associated too, this was a smaller effect. This is in line with findings which demonstrate that early-life adversity lays a critical foundation for health outcomes later in life, and there are already higher rates of chronic pain in adolescents who have reported one or more ACEs (Groenewald et al., 2020). By adulthood, ACEs can result in significant economic costs in the form of lost employment productivity and healthcare spending (NCSL, 2021). They are also associated with reduced adaptability, increased social isolation, reduced self-esteem, and increased rates of dissociation and anger hostility (NCSL, 2021). This highlights a substantial unmet need in treating adults with chronic pain who have a history of ACEs.

4.2 | The role of anxiety

The results of the meta-analysis demonstrated a moderate-sized significant association between ACEs and anxiety, as well as a moderate-sized significant association between anxiety and chronic pain. When reviewing the narrative synthesis, most studies still indicated there was still an association between anxiety and chronic pain when excluding ACEs from the relationship assessment, but it was not significant. Similarly, a multivariate analysis showed that all ACE measures were significantly associated with higher odds of anxiety in youth, with the most significant increase if there were more than four ACEs reported (Elmore & Crouch, 2020). Past research has clearly indicated long-term effects of ACEs on a variety of developmental problems, negative adult health outcomes (both psychological and physical), risky health-related behaviours, increased healthcare use, and higher financial burden (Bussières et al., 2020). In Europe and North America, for example, the total annual costs attributable to ACEs for the six main causes of health burden (cancer, diabetes, cardiovascular disease, respiratory disease, anxiety, and depression) were assessed to be between USD $417 and $487 billion; over 75% of this cost range was attributed to experiencing two or more ACEs (Bussières et al., 2020). Taken together, the findings highlight the importance of the ACE–anxiety relationship in the context of personal, societal, and economic burden.

The present results add to the growing evidence of the importance of the ACE–anxiety relationship in the context of chronic pain. The processing of pain is subject to different emotional and cognitive states across individuals (Tseng et al., 2017), many of which could be influenced by experiences of early-life adversity, trauma, or violence. Patients who are in chronic pain may struggle with daily life and social activity, which are often seen as due to anxiety (Dueñas et al., 2016). The two have a complex relationship, and the results of this review highlight the need to target this relationship more directly, hopefully leading to better patient treatment options, higher quality of life despite the chronic pain, and lower costs annually. Additionally, this review held value by attempting to summarize the associations between all three variables, particularly indicating that anxiety could be a mediator in the association between ACEs and chronic pain, something that needs to be explored in future research. Studies featuring ACE prevalence are informative, but policy and work settings do not reflect how this could be incorporated and applied to address these issues, such as by offering discrete screening options for employees on risk factors and providing appropriate accommodations if found.

4.3 | Strengths, weaknesses of the existing studies, and implications for future research

Strengths of the studies incorporated in this review include that some studies now also include neglect in the measurement of childhood adversity alongside abuse, which means this research will now be able to more comprehensively demonstrate the impact of ACEs beyond more commonly acknowledged forms of abuse. Furthermore, studies included a broad range of measuring chronic pain occurrence and intensity, which is likely to mean any associations with ACEs or anxiety are not underestimated. The meta-analyses did show an increased risk of chronic pain among those with ACEs and a small association between ACEs and chronic pain intensity, as well as moderate-sized significant associations between anxiety and chronic pain, and between ACEs and anxiety. Some key weaknesses were the known limitations of self-report measures, which are subject to recall bias, the potential for improper self-diagnosis, and gaps in a participant's memory due to the young age of abuse and/or memories missing due to trauma. However, these studies are still valuable and worth including in this review to provide a more robust sample for analysis. Including only studies of those with diagnoses would likely underestimate any associations between these variables, given that many individuals may not seek medical help for anxiety and/or chronic pain (Clark et al., 2017). In future research of this type, it is recommended that both diagnosis and self-report measures of ACEs and anxiety be included to maximize

potential understanding of the associations between these factors and chronic pain. However, well-validated standardized commonly used measures should be implemented where possible to enable comparison of associations across studies. Furthermore, studies incorporating ACE assessment should measure neglect and abuse and also seek to standardize the assessment of a broader range of pain outcomes. Finally, the age range in the included articles was somewhat limited, and it would be of value for studies to examine whether the impact of ACEs on anxiety and chronic pain is maintained well into older adulthood, that is, in those aged 65+ years.

4.4 | Practical implications and future directions

Chronic pain treatments and opiate abuse have been a topic for decades, but until the underlying mechanisms of pain are better understood, outcomes are unlikely to change, and treatments will continue to fall short (Phillips et al., 2017). By examining the potential influence anxiety has on chronic pain mechanisms via altered neurobiology potentially due to ACE history, and thus the corresponding impact on typical nerve behaviour, new treatment options could be developed. Historically, it is commonly known how impactful mirror therapy was for veterans and other individuals with painful phantom limb syndrome (Chan et al., 2019). Although this study had a very specific target population, it would be beneficial to examine the feasibility of perception-based treatment options in place of opiate prescriptions for individuals with anxiety and pain, particularly when considering the biological predispositions that may be present due to a history of childhood adversity.

The prevalence rates identified in this systematic review could be useful in better understanding the underlying mechanisms of how the brain may respond to trauma or violence, particularly for those struggling with anxiety and chronic pain that are resistant to standard treatment models or interventions. When considering that the origin of a patient's symptomology may be rooted in developmental dysfunction attributable to early-life adversity, it may help inform and encourage new treatment options that are not exclusively designed according to standard functioning models of human development. Although this meta-analysis highlights a potential mediating effect of anxiety in the ACE–chronic pain relationship, this was not possible to explore in the present analyses and warrants further investigation.

In addition, evidence-based precision health care has gained more traction in recent years. Although there are multiple evidence-supported psychotherapy (such as dialectical or cognitive behavioural therapy) and clinical intervention options, to date, no single approach, therapist, or treatment successfully helps every patient (Zilcha-Mano et al., 2022). Despite the prevalence of ACEs, many providers remain uncomfortable treating and recognizing trauma, particularly in the paediatric setting when the opportunity for intervention and prevention is still possible. In a hospital-wide survey assessing provider's comfort with trauma-informed care, less than 40% of staff members felt sufficiently equipped to screen for ACEs and only 34% felt they could make an informed, appropriate referral to follow-up trauma services. Additionally, 80.5% felt the resources available for identified survivors of trauma, ACEs, or violence were inadequate (Slater, 2021). While not everyone who has had an ACE is going to develop anxiety and later chronic pain, these types of screening factors could be a useful tool for assessing a patient's future risk and potentially improving the current attempts at establishing pathways for individualized, tailored care.

4.5 | Strengths and limitations of this review

As qualitative SLRs may be subject to interpretation bias, meta-analyses were also conducted, which follow a more objective and rigorous statistical procedure (Siddaway et al., 2019). Additionally, the present results—systematically summarizing over two decades of research—meaningfully add to the growing evidence on the importance of the ACE–anxiety relationship in the context of chronic pain in adults. However, there are some limitations to consider. Measures of anxiety in the included studies could be either by diagnosis or self-report, which covers a wide range of severity and includes non-diagnosed participants. However, the self-reports were in most cases based on standardized psychometric tools, increasing validity and giving a measure of severity. An important limitation was the wide variety of ACEs and chronic pain manifestations, resulting in variation in the methods, populations, and theoretical perspectives of the studies. Consequently, not every study could be included in the analysis for each association. Furthermore, including non-independent sample effect sizes can also potentially introduce bias through increasing the impact of one or two studies with multiple effect sizes contributing to the overall effect size. However, when more than two or three measures are used in multiple studies to be included in a meta-analysis, conducting sensitivity analyses for every pair of outcomes is not considered feasible (Scammacca et al., 2014). Another reason for non-independent effect sizes is that the effect sizes of the independent samples are nested within

a primary study (Cheung, 2019). Although averaging the effect sizes or selecting one effect size within a study may remove valuable within-study variations stemming from potential moderators, the effect sizes within a study may represent different types of measures and conditions. When performing the meta-analysis, there was heterogeneity in the constructed variables measured across studies; therefore, it was not considered prudent to further attempt to synthesize the relationships between effects across psychological measurements that were too heterogeneous across studies in the first place (Cheung, 2019). Other limitations included combining the reported findings from multiple countries, as there are different methods or reporting, different types of abuse categories, and potentially different levels of comprehension across translated questionnaires, particularly for abuse and violence and trauma terminology.

5 | CONCLUSIONS

Based on the results of this systematic review, there was a significant association between childhood adversities, anxiety, and chronic pain experiences in adults. The meta-analyses showed moderate associations between anxiety and chronic pain and between ACEs and anxiety and found that participants who experienced ACEs were almost twice as likely to present chronic pain during adulthood. Providers, educators, and those who work in mental health with adults who suffer from anxiety and chronic pain may benefit by also screening for a history of adversity, so they can more comprehensively support their patients/staff/students, potentially through a broader range of available treatments, and help them achieve more positive outcomes in adult life.

AUTHOR CONTRIBUTIONS

All authors contributed to drafting, read and reviewed the manuscript, and approved its submission to the *European Journal of Pain*.

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CONFLICT OF INTEREST STATEMENT

At the time of submission, all authors reported no conflict of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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