Barriers to Integrating ACE-Informed Evidence into Chronic Pain Care in Canada

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Assignment Acknowledgement

To maintain transparency and uphold academic integrity, we acknowledge that we used generative artificial intelligence tools, specifically ChatGPT and Grammarly, to assist with editing and reviewing our work for grammar and clarity.

Author Contributions

Student Name	Student Number	Contributions
Thibicka Thevan	251488261	Introduction, Recommendations for Future Research (Development of a Standardized Clinical ACE Measurement Tool for Chronic Pain + Evaluation of ACE-Informed Interventions and Chronic Pain Outcomes)
Damian French	251227315	Methods, Recommendation for Policy (Integrating ACE-Informed Principles into National Chronic Pain Policy)
Navreet Dhillon	251534314	Results, Recommendations for Practice (Interdisciplinary Healthcare Teams for Chronic Pain + Trauma-informed Education and Clinical Training for Providers)
Olayori Olasode	251215427	Discussion, Recommendations for Practice (Standard ACE Screening for Chronic Pain Patients), and Conclusion

Executive Summary

Names of Group Members: Navreet Dhillon, Thibicka Thevan, Olayori Olasode, Damian French

Date: March 20, 2026

Topic Area: Adverse Childhood Experiences and Chronic Pain

Statement of Problem: Chronic pain is one of the most prevalent and disabling health conditions in Canada, affecting nearly one in five Canadians, yet pain care often fails to address the neurobiological and psychosocial factors that contribute to its persistence. A large body of research demonstrates that adverse childhood experiences (ACEs) can cause long-term alterations in stress regulation, neuroimmune function, and pain processing. Despite this evidence, ACE-sensitive and trauma-informed approaches have not been systematically integrated into chronic pain assessment frameworks. This gap limits the effectiveness of pain care and widens inequities for populations with higher exposure to early life adversity.

Tentative Research Question: What are the barriers preventing translation of ACE-informed chronic pain care in Canada into clinical practice, and how can they be addressed across research, policy, and practice?

Current Progress to Date: A systematic literature review examined how trauma-informed frameworks have been applied in chronic pain care. Across the literature, higher ACE exposure was consistently associated with increased pain severity, psychological distress, and reduced quality of life. Through our systematic review, we identified a need for trauma-informed care; however, the extent to which this has been translated into clinical practice remains scarce. Several key gaps that may contribute to this were identified, including variability in ACE measurement, inconsistent provider education and training, and a lack of standardized frameworks and policy to support implementation.

Challenges & Barriers: Few studies have directly evaluated ACE-informed interventions, with most focusing on associations rather than implementation. This shifted the project toward identifying research and system-level barriers.

Next Steps: The findings of this review will be disseminated through a poster presentation at the London Health Research Day, providing an opportunity to share them with clinicians, researchers, and trainees. More broadly, this work contributes to ongoing efforts to bridge the gap between research, policy, and practice in chronic pain care by promoting more integrated, trauma-informed care models.

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Barriers to Integrating ACE-Informed Evidence into Chronic Pain Care in Canada

Introduction

Chronic pain, defined as persistent or recurring pain lasting beyond three months, is among the most common health conditions in Canada. It affects nearly one in five individuals nationwide (Health Canada, 2021; Nicolson et al., 2023). Women and seniors report higher rates of chronic pain compared to the general population, and chronic pain incurs approximately $38.2 to $40.3 billion annually in healthcare costs and lost productivity (Health Canada, 2021). Despite the prevalence and impact of chronic pain, treatment in Canada remains inconsistent and fragmented. Chronic pain is still frequently approached as a purely biomedical problem, even though research increasingly shows that it arises from a combination of physical, psychological, and social factors (Pianese & Bordoni, 2025). Psychological stress and social environments influence how pain is processed and maintained. Among these influences, adverse childhood experiences (ACEs) have emerged as powerful predictors of chronic pain, shaping brain development, and increasing vulnerability to pain in adulthood (Bussières et al., 2023).

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ACEs refer to traumatic or stressful events that occur during childhood, including exposure to abuse, neglect, or household instability (Tidmarsh et al., 2022). More than three-quarters of adults with chronic pain report experiencing at least one ACE, and nearly half report multiple ACEs, meaning they experienced more than one type of childhood trauma (Craner et al., 2022). ACEs influence pain through multiple mechanisms, including dysregulation of the hypothalamic-pituitary-adrenal (HPA) axis, increased neuroinflammation, and maladaptive neuroplasticity (Burke et al., 2017). Repeated exposure to stress during childhood can disrupt the HPA axis, which regulates stress hormones and immune responses. These disruptions alter brain development, affect stress regulation, and heighten pain sensitivity (Tidmarsh et al., 2022). Chronic activation of stress pathways also promotes neuroinflammation, leading to

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irregular cortisol levels and increased production of inflammatory mediators such as interleukin-6 (IL-6) and tumour necrosis factor alpha (TNF-α) (Hakamata et al., 2022). Lower cortisol reactivity reduces the body's ability to suppress inflammation, while elevated IL-6 and TNF-α levels further promote inflammatory processes that sensitize neural pathways.

Neuroimaging studies reinforce these findings by showing that ACEs are associated with structural and functional changes in regions such as the prefrontal cortex, amygdala, hippocampus, and anterior cingulate cortex, which regulate emotion, cognition, and pain processing (Bick & Nelson, 2016). These disruptions interfere with normal brain maturation and synaptic pruning, contributing to maladaptive patterns of neuroplasticity (Smith & Pollak, 2020). Individuals exposed to early adversity are therefore more susceptible to central sensitization, a condition in which the nervous system becomes hyper-responsive to sensory input, amplifying pain perception. As a result, people with a history of childhood trauma often experience heightened pain sensitivity and persistent pain even in the absence of injury (Tidmarsh et al., 2022; Song et al., 2024). Collectively, these findings demonstrate that the connection between ACEs and chronic pain is not solely psychological. Trauma experienced in childhood produces measurable changes in biological systems that increase vulnerability to pain throughout adulthood.

Despite this growing body of evidence, Canada's chronic pain care system has not adequately integrated trauma-informed approaches into routine practice. This shortcoming has led to care that focuses on symptom management rather than addressing the root causes of pain, perpetuating cycles of suffering for one in five Canadians (Lynch, 2011). Importantly, only twenty five percent of Canadian multidisciplinary pain treatment centers accept patients with co-occurring mental health or substance use disorders, excluding many of those most affected by trauma and adversity. Pain clinics across the country often operate within fragmented models because care is poorly coordinated, screening for psychosocial and trauma-related factors is inconsistent, services are disconnected, and many high-need patients are excluded (Bosma et

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Deleted: Pain clinics across the country often operate within fragmented models that overlook the psychosocial and trauma-related dimensions of pain. Only 25 percent of multidisciplinary pain treatment centers accept patients with co-occuring mental health or substance use disorders, excluding many of those most affected by trauma and adversity al., 2024). This exclusion emphasizes systemic inequities in how pain services are structured and delivered.

The problem is compounded by a shortage of clinicians trained in pain neurobiology and trauma-informed care, long wait times, and geographic disparities that leave rural and marginalized populations with little or no access to specialized services. As a result, patients often cycle through emergency and primary care systems without lasting relief, receiving pharmacological or procedural interventions that do not address the biopsychosocial mechanisms underlying chronic pain (King & Fraser, 2013). Although the 2017 Canadian Guidelines for Opioid Therapy and Chronic Non-Cancer Pain encourage non-pharmacological therapies, they do not explicitly incorporate trauma-informed care principles such as recognizing patient trauma histories, ensuring psychological safety, and emphasizing patient empowerment (Busse et al., 2017).

As mentioned, this wicked problem is complex, multidimensional, and resistant to single-sector solutions. Chronic pain arises from interactions between biological, psychological, and social factors that unfold across the lifespan (Bosma et al., 2024). However, current Canadian policies and standards of care remain narrowly focused, neglecting how trauma, stress, and social determinants increase risk of chronic pain across generations. The consequences extend beyond persistent patient suffering to include growing distrust in healthcare, stigma surrounding trauma-associated pain, and disengagement from care.

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Understanding why this disconnect persists requires examining the broader translational gap between research, policy, and practice. Although there is strong and consistent evidence linking ACEs, altered neurobiology, and chronic pain, these findings have not been systematically translated into clinical or policy frameworks in Canada. This lack of translation reflects the absence of standardized national frameworks that guide how trauma-informed and ACE-related evidence should be integrated into chronic pain assessment, treatment planning, and provider training. The gap between what is known and what is practiced has become a defining challenge in Canadian pain care.

By examining chronic pain within the intersecting domains of neuroscience, psychology, and health systems research, this project explores how knowledge about ACEs and neurobiological mechanisms has yet to be meaningfully integrated into care delivery. The wicked problem of chronic pain cannot be addressed through biomedical interventions alone. Rather, progress depends on bridging this translational gap so that emerging evidence on trauma, adversity, and brain-body interactions can inform the development of more equitable, trauma-informed, and patient-centered pain care systems in Canada. Thus, this review aims to examine current approaches to trauma-informed pain care, the barriers that continue to limit their translation into clinical practice, and to provide recommendations across research, policy, and practice to strengthen chronic pain care in Canada.

Methods

This review was guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) framework (Page et al., 2021).

Search Strategy

A search was performed across two major databases, including PubMed and the Web of Science. These databases were chosen because they provide comprehensive coverage of biomedical, psychosocial, and interdisciplinary research relevant to chronic pain and trauma. PubMed captures studies in neuroscience, clinical medicine, and health policy. Whereas the Web of Science was included for broader interdisciplinary studies, that may not be included in medical databases. The search strategy included three main domains, including chronic pain, adverse childhood experiences, and trauma-informed care models. The final search string included:

1. “chronic pain” OR “persistent pain” OR “pain management” OR “pain disorder” OR “central sensitization” OR “fibromyalgia” AND
2. “adverse childhood experiences” OR “ACEs” OR “ACE” OR “childhood trauma” OR “child abuse” OR “child neglect” OR “early life stress” OR “early life adversity” AND
3. “trauma-informed care” OR “trauma-informed practice” OR “assessment” OR “screening” OR “instrument” OR “questionnaire” OR “tool” OR “measure” OR “scale” OR “survey” OR “checklist” OR “framework” OR “model” OR “evaluation” OR “psychosocial” OR “biopsychosocial”

Additionally, the search was limited to peer-reviewed articles published between 2020 and 2025, to reflect the current implementation of trauma-informed chronic pain care.

Screening Procedures

The results obtained from the literature search were compiled and screened by title and abstract by four investigators (ND, TT, OO, DF). Following the initial round of screening, full text review was completed by the same four investigators to extract the final set of articles for the review. Any disagreements during screening or full-text review were resolved through group discussion until consensus was reached. After entering the search results into Microsoft Excel, the four investigators performed title and abstract screening and full-text review without using any other review management software.

The studies were screened using inclusion and exclusion criteria (Table 1) that aligned with the review’s objectives of identifying barriers to the integration of ACE-informed evidence within chronic pain care systems. Studies were initially screened by title and abstract, and only full-text peer-reviewed primary journal articles in English were included. The inclusion and exclusion criteria were determined using the PICO framework, as outlined in Table 1.

Table 1

Study Inclusion/Exclusion using PICO Framework

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PICO Element	Inclusion Criteria	Exclusion Criteria
Population (P)	Individuals of any age experiencing chronic pain including: - Participants with a clinical diagnosis of chronic pain - Participants with self-reported chronic pain lasting longer than three months - Clinicians, health care providers, or trainees involved in the assessment, management, or delivery of chronic pain care.	- Studies focused on acute, post operative, or cancer related pain - Studies where chronic pain is not a primary outcome
Intervention (I)	Studies describing or evaluating: - Interprofessional, multidisciplinary, or trauma-informed chronic pain management models or interventions - Validated ACE measures or screening tools used in assessing chronic pain outcomes	- Studies focusing only on pharmacological methods without psychosocial or interprofessional component - Studies examining only biological or mechanistic pathways that are unrelated to trauma
Comparator (C)	Not required. Studies with or without comparison groups were eligible for inclusion.	
Outcome (O)	Studies reporting on at least one of the following outcomes: - Access to care or service delivery - Patient reported outcomes on pain - Trauma-informed practice integration or evaluation	- Studies reporting only biological/physiological outcomes - Studies that do not have data relevant to trauma-informed care or ACE assessment

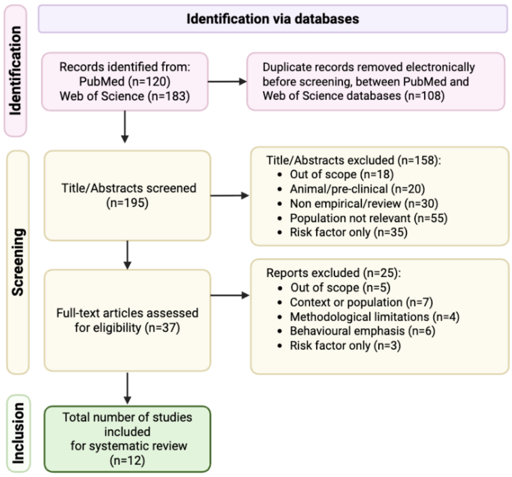
Note. ACE = Adverse Childhood Experience. PICO = Population, Intervention, Comparator, Outcome.

These criteria were selected to capture the barriers to trauma-informed integration. Studies with validated ACE measures were also included, even when they did not explicitly evaluate trauma-informed care interventions, to provide insight into how screening is currently implemented. For each article, key details were manually reviewed, including study objectives, ACE measures used, and findings related to trauma-informed or chronic pain care. Notes were compiled in Excel and organized into broad themes to guide the narrative synthesis. Data was synthesized using an inductive thematic analysis approach, where themes were identified based on reoccurring patterns across studies (Braun & Clarke, 2006).

Results

The results of the search and screening process are presented in Figure 1; following full-text review, twelve studies met the inclusion criteria. Analysis of these studies, using inductive thematic analysis, revealed four key themes: (1) approaches to measuring ACEs, (2) associations between ACEs and chronic pain, (3) interventions incorporating interdisciplinary and ACE-informed approaches, and (4) provider education and training.

Figure 1



Note. The PRISMA figure summarizes the identification, screening, and inclusion process for studies retrieved from PubMed and Web of Science databases.

Approaches to Measuring Adverse Childhood Experiences in Chronic Pain Populations

Recent studies have assessed ACEs in chronic pain populations using self-report questionnaires, with approaches varying by population and scoring method. In youth populations, Nelson et al. (2025) employed the ACE Questionnaire, coding both ACE count (0, 1, 2, 3+) and type (maltreatment only, household dysfunction only, both), reporting exposure frequencies for subtypes. Similarly, adult populations were assessed using tools such as the Childhood Trauma Questionnaire (CTQ) and Life Events Checklist (LEC-17), which captured physical and emotional abuse, neglect, and cumulative trauma exposure across multiple domains (Costa et al., 2025; Ribeiro et al., 2024).

Some studies extended ACE measurement to explore psychological correlates of chronic pain. Heule et al. (2024) and Badri et al. (2025) calculated cumulative ACE scores and reported associations with negative affect, pain catastrophizing, and perceived injustice in multidisciplinary care contexts. Similarly, Craner et al. (2022) found that higher ACE counts (≥3–

4) were associated with worse mental health, pain outcomes, and quality of life. Ribeiro et al. (2024) further distinguished lower versus higher trauma levels using threshold-based approaches, emphasizing differences in emotional neglect, abuse, and physical abuse prevalence.

Nelson et al. (2025) and Heule et al. (2024) emphasized cumulative scoring, while Ribeiro et al. (2024), Costa et al. (2025), Badri et al. (2025), and Craner et al. (2022) captured subtype-specific exposure or linked ACE counts to clinical outcomes. Ribeiro et al. (2024) additionally applied thresholds to distinguish lower versus higher trauma levels. In contrast, cumulative-only approaches did not provide subtype or threshold distinctions. Overall, measurement approaches differed in terms of scoring (cumulative versus subtype), reporting of prevalence rates, and use of thresholds, with ACE prevalence, type, and severity reported differently depending on the method applied, the population studied, and study design considerations.

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Associations and Mechanistic Pathways Linking ACEs and Chronic Pain

The relationship between ACEs and chronic pain is not explained by a single mechanism, but rather through an integration of neurobiological and psychological processes that act in tandem across the lifespan. Within a large Finnish cohort of mid-life employees, exposure to ACEs such as parental illness, family conflict, and bullying was significantly associated with chronic pain in adulthood (Salonsalmi et al., 2021). This study emphasized that the co-occurrence of multiple adversities, rather than any single exposure, strongly predicts pain. Clinical data support these epidemiological findings in an interdisciplinary pain-rehabilitation cohort where 78.5% of adults reported at least one ACE, and those with 3 or more ACEs presented with greater mental-health comorbidity (Craner et al., 2021). However, all groups demonstrated comparable improvements in pain and physical function, thereby suggesting that having an ACEs history indicated clinical complexity, demonstrating how pain is ACE-related and multidisciplinary (Craner et al., 2021).

A key mechanism linking ACEs and chronic pain is dysregulation of the HPA axis and related neuroendocrine systems. In a large case-control study of 151 patients with musculoskeletal disorders (MSD) and 149 control patients, Achenbach et al. (2022) demonstrated a distinct hormonal profile characterized by lower cortisol and insulin-like growth factor-1 (IGF-1) and higher leptin and follicle-stimulating hormone (FSH) among female patients. Both childhood trauma, measured by the CTQ, and chronic stress (Trier Inventory for chronic stress) predicted MSD diagnosis directly and indirectly, though elevated leptin levels. These findings suggest that leptin and cortisol mediate the relationship between ACEs, chronic stress, and pain-related disorders.

Beyond the endocrine mechanism, ACEs exert their influences on pain through psychological pathways. In a clinical study of adults with chronic lower back pain, Thomas et al. (2024) found that emotional dysregulation fully mediated the relationship between ACE exposure and both pain intensities. This indicates that early adversity increases pain vulnerability by shaping affective and cognitive reactivity, and overall magnifying pain perception. Similarly, Riberio et al. (2025) showed that among Spanish women with fibromyalgia and depression, emotional neglect and abuse were prevalent in trauma types, and these experiences predicted higher depression scores and greater self-reported pain severity. These findings support a trauma-emotion-pain pathway where unresolved ACEs promote chronic negative effects, dysregulated stress evaluation, and enhance central pain amplification. Taken together, these findings demonstrate that ACEs influence chronic pain through interconnected biological and psychological pathways.

Trauma-Informed and ACE-Integrated Interventions in Pain Management

Two studies evaluated structured, multimodal interventions for adults with chronic pain while testing whether ACE burden moderated outcomes. Both used a biopsychosocial framework with movement or reconditioning, pain education, and psychological skills training, and stratified analyses by ACE tiers (Craner & Lake, 2021; Prasad et al., 2025).

In an outpatient interdisciplinary rehabilitation program studied by Craner and Lake (2021), ACE burden was measured with the standard 10-item ACE questionnaire and grouped into 0, 1-2, or 3+ categories. From admission to discharge, both average pain and pain interference decreased while physical and mental health T-scores improved. Additionally, pain catastrophizing declined, and pain self-efficacy increased. Groups did not differ on pain or physical function at intake or discharge, and no group-by-time interactions were detected, indicating similar improvement across ACE tiers.

In the Movement, Mindfulness, and Pain Science (MaPS) class studied by Prasad et al. (2025), ACE burden was defined as an intake ACE score on a 0 to 10 scale and grouped as 0, 1 to 3, or 4 to 10. From the start to the end of the 8-week class, the Patient-Specific Functional Scale increased (mean 2.5 to 5.1; Δ 2.5, 95% CI 2.2 to 2.9, $p < .001$), pain catastrophizing decreased (median 19 to 11, $p < .001$), and quality of life increased (median 5 to 6, $p < .001$). Lower-extremity strength improved (30-second sit-to-stand median 8 to 11 repetitions, $p < .001$), and the proportion completing all four balance stages rose (39% to 56%, $p = .001$). Higher ACE tiers had worse baseline psychosocial profiles, but the size of improvement did not differ between tiers. Mean pain intensity was not collected in this study.

Across both programs, participants with higher ACE burden began with less favourable psychosocial profiles, and all groups improved during treatment. Formal tests did not detect significant differences in improvement magnitude by ACE tier, and discharge pain and physical function were comparable between groups. Together, these results suggest that when interventions combine physical reconditioning, pain education, and coping skills, ACE burden marks baseline complexity, but does not appear to moderate short-term gains within the outcomes assessed.

Provider Education and Training in ACE-Informed Practices

Building on the findings regarding interdisciplinary and trauma-informed interventions, a small number of studies also discuss provider education or training in relation to trauma-informed care. Across the studies, training appeared in different formats, ranging from structured educational to informal sessions within interdisciplinary programs. Katzman et al. (2025) evaluated the ACEs Extension for Community Healthcare Outcomes (ECHO) tele-mentoring program for school-based clinicians. The program delivered a series of virtual, interprofessional educational sessions focused on identifying ACEs, using validated screening tools, and applying trauma-informed communication strategies. Participants completed surveys before and after the program and showed a significant improvement in confidence scores and reported greater familiarity with ACE screening tools.

Additionally, a study by Craner and Lake (2021) described practices within a multidisciplinary center where clinicians were trained in transdiagnostic treatment approaches in pain psychology and neuroscience. The results showed that patients with this treatment intervention achieved significant clinical improvements. However, ACE questionnaires were administered at intake, but not specifically used in treatment planning, and the primary goal of the study was not to evaluate clinician training, but rather to assess the effectiveness of the treatment intervention on pain outcomes. Similarly, the MMaPS program conducted by Prasad et al. (2025) trained clinicians to provide a multimodal approach that includes mindfulness facilitation and pain science education. Although patient outcomes improved across multiple measures, clinician training outcomes were not assessed.

Across the reviewed studies, education and training initiatives were inconsistently applied and differed in scope. Structured programs such as the ACEs ECHO model show that there are measurable increases in clinician confidence, although most pain studies rely on informal instruction or previous training. Although some programs included elements of clinician preparation, systematic training in ACE-informed or trauma-informed practice was uncommon across the reviewed literature.

Discussion

This review sought to explore the extent to which ACE and trauma-informed frameworks have been applied in chronic pain care and identify the barriers that limit their implementation. Across diverse clinical, epidemiological, and community studies, a consistent association has been identified between ACEs and chronic pain. Evidence from research on youth with chronic pain, adults with fibromyalgia, and patients experiencing orofacial or urogenital pain (Nelson et al., 2025; Ribeiro et al., 2024; Badri et al., 2025; Heule et al., 2024) reveals that higher ACE exposure is linked to greater pain severity, elevated psychological distress, and reduced quality of life. Although studies varied in their use of diagnostic tools such as the ACE Questionnaire, CTQ, and Life Events Checklist (Costa et al., 2025), the findings consistently demonstrate that early adversity meaningfully contributes to long-term pain vulnerability. Mechanistic evidence further supports this link: ACEs disrupt stress regulation via the HPA axis and emotional dysregulation, which amplifies pain perception (Achenbach et al., 2022; Thomas et al., 2024).

Intervention studies such as those by Craner and Lake (2021) and Prasad et al. (2025) emphasize that trauma-informed approaches and coping-based interventions significantly improve pain interference, self-efficacy, and quality of life, even among individuals with high ACE exposure. While participants with elevated ACE scores often begin treatment with poorer psychosocial profiles, they demonstrate comparable improvements when trauma-informed principles are applied.

The evidence demonstrates a clear, multidimensional link between ACEs and chronic pain. To optimize outcomes, trauma-informed principles must be systematically embedded into clinical assessment, interdisciplinary treatment planning, and professional training to address the biopsychosocial realities of pain more specifically.

Integrating Mechanisms, Measurement, and Clinical Translation of ACEs in Chronic Pain

The mechanistic pathways linking ACEs to chronic pain further illustrate the complexity of this relationship. Epidemiological and clinical data indicate that exposure to multiple adversities, rather than any single type of trauma, predicts adult chronic pain and comorbid mental health conditions (Salonsalmi et al., 2021; Craner et al., 2021). Neuroendocrine mechanisms, including HPA axis dysregulation and altered hormonal profiles, appear to mediate the effects of early adversity on pain vulnerability (Achenbach et al., 2022). Psychological pathways, particularly emotional dysregulation, further amplify pain perception and are closely associated with unresolved trauma (Thomas et al., 2024; Ribeiro et al., 2025). Collectively, these findings suggest that ACEs exert their influence across multiple, interacting biological and psychological systems, emphasizing the need for integrative, trauma-informed approaches to chronic pain care.

Critically, the intersection of measurement variability and mechanistic complexity reveals deeper challenges in translating research into practice. Without standardized and clinically actionable ACE assessment tools, the detailed mechanistic knowledge uncovered by studies cannot effectively inform individualized treatment planning. This issue represents both a methodological and conceptual limitation, as research frames trauma in additive terms, potentially oversimplifying the interactive effects of different types and severities of adversity. Bridging this gap requires assessment strategies that capture cumulative burden, subtype distinctions, and severity thresholds, while remaining practical for clinical application. Doing so would allow clinicians to integrate biological and psychosocial insights, ultimately supporting personalized, ethically responsive, and effective chronic pain management (Prasad et al., 2025). This translation gap further emphasizes the need for system-level standardization to ensure that advances in mechanistic research are consistently integrated into routine clinical care.

Limitations of Standardized Intervention Models

In both intervention studies, ACE tiers were used to organize outcome analyses rather than to guide individual care (Craner & Lake, 2021; Prasad et al., 2025). Participants were assigned to tiered groups to test differences in outcomes; however, treatment content, timelines, and available supports were delivered as standardized, multimodal packages rather than being adjusted according to ACE tier. This approach is common in the available literature because tiered ACE counts are easy to collect and compare. The overarching issue with this system is that it transforms ACE screening into an analytical benefit rather than a clinical decision-making tool. These findings reflect a broader system-level gap, where the absence of structured clinical guidelines prevents ACE information from being operationalized in treatment planning.

Across the broader literature, higher ACE burden consistently aligns with more challenging pain-related psychosocial profiles before starting treatments, which include greater pain catastrophizing, lower pain self-efficacy, and less physical functioning (Tidmarsh et al., 2022). These are the same areas that current treatment interventions aim to address. Despite these observed baseline differences, current intervention models do not consistently incorporate ACE-related variability into treatment design, limiting their ability to address individual patient needs.

The primary gaps in treatment lie in implementation and equity, not in effectiveness. Most available studies stratified outcomes among participants but did not report access, attendance, or overall completion rates by ACE tier, making it challenging to see where and why participants disengage from treatment. One intervention study reported approximately 30 percent attrition but did not specify drop-out rates by ACE tier (Prasad et al., 2025). The ACE distribution table, therefore, describes completers only, so it cannot show whether retention differed by tier. Without intake counts per tier and matching completer counts, it is not possible to estimate tier-specific completion rates or to determine whether attrition biased the findings. Additionally, without these metrics, it is unclear whether certain ACE tier groups faced greater challenges or had worse experiences with the interventions.

Inconsistent Application of Trauma-Informed Education and Clinical Training

The reviewed interventions demonstrated that interdisciplinary, biopsychosocial programs can improve pain and psychosocial outcomes for adults with chronic pain (Craner &

Lake, 2021; Prasad et al., 2025). However, these programs rarely tailored care based on trauma exposure, and the role of provider preparedness in these improvements remains underexplored. The absence of trauma-specific education among clinicians may partly explain why ACE and trauma-informed principles are often acknowledged but not explicitly applied in treatment planning. Interventions that incorporate physical reconditioning, mindfulness, and psychological skills training show clear benefits without a parallel effort to train clinicians in trauma-informed communication and assessment (Bosma et al., 2024; Prasad et al., 2025). Across the reviewed studies, clinician education appeared inconsistent and often insufficient, with few opportunities for structured or ongoing learning. When targeted initiatives were introduced, such as the ACEs ECHO tele-mentoring program designed to build trauma-informed practice, clinicians demonstrated greater confidence and comfort when engaging with ACE-related discussions (Katzman et al., 2025). However, such programs remain rare, which reflects a broader system-level gap where the absence of standardized training expectations prevents the consistent integration of trauma-informed care into chronic pain management.

Recommendations

Collectively, the findings from this review demonstrate a clear and persistent translational gap between ACE-informed care and its application in chronic pain care. Variability in ACE measurement, limited assessment of trauma-informed pain interventions, and inconsistent provider training all contribute to this gap. Addressing these gaps requires a coordinated effort across research, policy, and clinical practice. The following recommendations are therefore informed by the limitations identified and aim to support the implementation of trauma-informed chronic pain care in Canada.

Recommendations for Future Research

Development of a Standardized Clinical ACE Measurement Tool for Chronic Pain

A critical research priority is the development and consistent adoption of a standardized clinical ACE measurement tool for use in chronic pain populations. Currently, ACE tiers are frequently used to organize outcome analyses but are rarely applied to guide intervention design, scoring is inconsistent, and tier cutoffs are variable (Craner & Lake, 2021; Prasad et al., 2025). As a result, ACE screening is used for analytical benefit rather than as a tool for systematically examining baseline differences in psychosocial profiles, including pain catastrophizing, self-efficacy, and physical functioning (Tidmarsh et al., 2022). A validated, standardized tool would allow researchers to compare results across studies, identify patterns in baseline characteristics, and link ACE burden directly to intervention outcomes.

Future research should explicitly adopt or develop a tool with clearly defined scoring procedures, tier classifications, and administration protocols. Data collection should include ACE assessments alongside validated measures of psychosocial variables, functional status, and longitudinal outcomes. Intervention studies should prioritize participants with high ACE burden for enrollment, adapt program content, pacing, and sequencing, and provide additional behavioural health support when indicated. Short, structured follow-ups should be used to monitor engagement, clarify coping strategies, and ensure participant safety. Transparent reporting of intake, attendance, and completion rates by ACE tier is essential to evaluate equity and identify where program refinements are needed (Sandoe et al., 2023).

Additionally, further research is needed to clarify how different numbers or types of ACEs may influence prognosis, as emphasized by Sandoe et al. (2023), and how outcomes evolve over extended follow-up periods. Analyses should include tier-stratified comparisons, regression modelling controlling for demographic factors, and pooled or meta-analytic approaches when multiple studies adopt the same tool. Large, diverse samples, including adult and pediatric chronic pain populations, are critical to ensure generalizability and detect tier-

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specific patterns. Developing and implementing a standardized ACE measurement tool in this way addresses major gaps in comparability, reproducibility, and intervention refinement.

Evaluation of ACE-Informed Interventions and Chronic Pain Outcomes

A second key research priority is to rigorously evaluate ACE-informed interventions that adjust content, pacing, and support based on ACE burden. Current studies often assign participants to ACE tiers to stratify outcomes, but interventions are delivered as standardized, multimodal packages that fail to account for baseline differences in psychosocial vulnerability or functional impairment (Craner & Lake, 2021; Prasad et al., 2025). This gap is particularly significant for pediatric populations, where youth with three or more ACEs are at higher risk for persistent depressive and anxiety symptoms, posttraumatic stress symptoms (PTSS), and reduced quality of life (Nelson et al., 2021). Without ACE-informed design, interventions may not address the domains most relevant to higher-risk participants. Future research should use comparative intervention designs in which participants are randomized to standard treatment or ACE-informed models that vary with sequencing, intensity, and psychosocial support by ACE tier. A practical approach is to use the baseline differences to decide intervention program design, including what content is delivered, in what order, how quickly, and what extra support to provide. ACE tier classification can be used to determine the need for treatment, with individuals in higher-tier groups prioritized entry into available programs. Additionally, after patients are placed in tiered groups, short follow-ups can be used to clarify safety concerns, identify effective coping strategies, and address other practical aspects. Once collected, this information can then shape the sequence and pace of the program, signal when to add behavioural health support, and determine additional elements needed to keep participants safe and engaged in treatment.

Data collection should include standardized ACE assessments, PTSS screening, validated psychosocial and functional measures, and, when feasible objective biomarkers to confirm biological correlates of chronic pain (Nelson et al., 2021). Researchers should meticulously track participant flow, including intake counts, session attendance, and completion by ACE tier. Analyses should include tier-stratified outcome comparisons, intention-to-treat models, and sensitivity analyses to evaluate the impact of differential attrition and to determine whether outcomes vary by ACE tier. Transparent reporting on access and retention by tier, combined with the use of ACE information to guide pacing, add support, and coordinate referrals with follow-up, would make these programs more actionable for those most affected.

In addition, longitudinal designs with multiple follow-up points are critical to assess how outcomes evolve over time across ACE tiers and whether early intervention effects are sustained. Populations should be diverse, including pediatric and adult cohorts, first-onset pain presentations, and post-surgical samples. Studies should compare ACE-informed interventions with standard care in terms of retention, engagement, pain severity, psychosocial outcomes, and functional improvements. Incorporating PTSS assessments and biomarkers will improve understanding of the mechanisms linking ACE exposure to chronic pain trajectories. Transparent reporting of both intervention outcomes and participation metrics by ACE tier will enable researchers to identify which approaches are most effective for participants with high ACE burden, address equity gaps, and refine future interventions (Nelson et al., 2021; Sandoe et al., 2023).

Recommendation for Policy

Integrating ACE-Informed Principles into National Chronic Pain Policy

Addressing the persistent gap between ACE-related research and clinical practice requires a coordinated policy response that acts at the systems level. In Canada, this can be achieved by developing and phasing in national trauma-informed chronic pain care standards. These standards will require the integration of ACE-informed and trauma-informed principles into chronic pain assessment, treatment planning, referral pathways, and provider education. Ultimately, these standards define what trauma-informed chronic pain care should include, while the following components outline how these expectations can be implemented within the healthcare system.

Establishing standardized ACE-informed clinical and educational expectations directly addresses the key gaps identified in this review by enabling consistent use of ACE-related information in clinical settings, strengthening provider preparedness through trauma-informed training, and creating structured pathways for translating trauma-related evidence into routine chronic pain care. Although Canada has recognized chronic pain as a major public health issue, current policy and care delivery remain fragmented as trauma-informed approaches are not yet consistently embedded across chronic pain systems (Health Canada, 2021; Bosma et al., 2024). Establishing national standards would create a consistent foundation for trauma-informed chronic pain care across Canada, while allowing provinces and territories to tailor implementation through regional care pathways, resource allocation, and service delivery models that align with local population needs.

This proposal does not introduce a new standalone policy but instead outlines the development and integration of trauma-informed chronic pain care standards within existing Canadian policy frameworks, such as the Canadian Pain Task Force and its Action Plan for Pain in Canada (Health Canada, 2021). The Action Plan was developed as a national framework to improve how pain is understood and prevented across the country. The plan outlines priorities for equitable, patient-centered care, education and training, research, and system-level monitoring (Health Canada, 2021). Embedding trauma-informed standards within these existing structures allow for alignment with current national priorities while avoiding the need to establish a new policy stream.

The implementation of these standards should be supported by coordinated system-level changes that enable consistent, sustainable integration into practice. Governments and health systems should establish standardized clinical guidance on how to collect and use ACE- and trauma-related information in pain care in ways that prioritize safety, patient choice, and ethical responsiveness (Tidmarsh et al., 2022). Trauma-informed competencies should be embedded into healthcare education, continuing professional development, and interdisciplinary team training so that clinicians are better prepared to recognize and respond to trauma-related contributions to chronic pain (Gerber et al., 2024; Goldstein et al., 2024). Subsequently, health systems should support integrated service pathways linking chronic pain care with mental health and substance use services, particularly for patients dealing with overlapping psychosocial and clinical complexity related to their chronic pain (Bosma et al., 2024). Additionally, governments should establish monitoring and accountability measures, including performance indicators such as access to interdisciplinary care, patient retention, equity of service delivery, and completion of trauma-informed training. These indicators are essential for evaluating whether standards are being implemented effectively and consistently across jurisdictions, and for identifying gaps in access or quality of care over time. Together, these changes allow the proposed standards to be embedded within existing Action Plan priority areas, including clinical care guidance, provider education frameworks, and system-level evaluation structures.

In conjunction with broader implementation efforts, these approaches should be implemented in a staged, coordinated manner across different levels of government. At the federal level, Health Canada can use the Canadian Pain Task Force framework to bring together provincial, territorial, clinical, research, and lived-experience partners to define the core set of national trauma-informed chronic pain standards (Health Canada, 2021). Provinces and territories can then translate these standards into regional care pathways, accreditation expectations, and continuing professional development requirements, ensuring alignment with existing healthcare structures. Because the Canadian Pain Task Force functions in an advisory capacity, effective implementation will require formal adoption by ministries of health, health authorities, educational institutions, and professional regulatory bodies to prevent continued variation across jurisdictions. Taken together, integrating trauma-informed standards into the existing Canadian Pain Task Force framework provides a realistic and evidence-informed pathway for translating ACE-related evidence into more consistent, equitable, and trauma-informed chronic pain care in Canada.

Recommendations for Practice

Interdisciplinary Healthcare Teams for Chronic Pain

An important recommendation for practice is the expansion of interdisciplinary healthcare teams within chronic pain care. Chronic pain is increasingly understood as a condition shaped by interacting biological, psychological, and social factors, yet care is often delivered through fragmented models that focus primarily on physical symptoms (Connell et al, 2022). This approach can be particularly limiting for individuals with histories of ACEs, whose pain may also be influenced by trauma-related stress responses, emotional dysregulation, and mental health comorbidities (Thomas et al., 2024). Interdisciplinary models offer a framework for addressing these interacting factors by allowing multiple dimensions of pain to be assessed and treated simultaneously (Craner & Lake, 2021).

Interdisciplinary teams enable clinicians to apply the biopsychosocial model in practice through coordinated assessment and collaborative treatment planning (Kovačević et al., 2024). In these settings, physicians, psychologists, physiotherapists, nurses, and social workers can collectively evaluate the physical, emotional, and social drivers of pain and develop comprehensive care plans that extend beyond symptom management. Multimodal programs that integrate physical rehabilitation, pain education, and psychological support have demonstrated meaningful improvements in patient functioning and well-being, even among individuals presenting with complex pain (Craner & Lake, 2021). Compared with single-modality interventions, integrated care models have also been associated with broader system-level benefits, including reduced reliance on opioids, lower healthcare utilization, decreased sick leave, and improved return-to-work outcomes (Connell et al., 2024; Kovačević et al., 2024).

Expanding interdisciplinary care in practice may involve strengthening collaboration between primary care providers, mental health professionals, and rehabilitation specialists within chronic pain services (Connell et al., 2024). This could include implementing joint patient assessments, developing shared treatment plans across disciplines, and integrating psychological and social support within pain clinics and community care settings. Examples from clinical practice demonstrate how interdisciplinary approaches can support more individualized care. When care teams assess patients using a biopsychosocial framework, clinicians are better able to identify psychological distress, social stressors, and barriers to treatment engagement that may otherwise remain unaddressed (Reaume, 2023). Addressing these factors alongside physical symptoms can improve patient engagement and coping while reducing pain-related distress. Expanding interdisciplinary pain teams across primary care and specialized pain services may therefore represent an important step toward integrating trauma-informed and ACE-informed evidence into routine chronic pain management.

Trauma-Informed Education and Clinical Training for Providers

The consistent mechanistic evidence linking ACEs with chronic pain also emphasizes the need for stronger trauma-informed education and clinical training among healthcare providers involved in chronic pain management. Although interdisciplinary teams can bring together expertise from multiple disciplines, their effectiveness depends on clinicians having the knowledge and skills required to recognize how trauma influences health and pain experiences. Individuals seeking chronic pain care increasingly present with complex mental health needs, trauma histories, and social stressors that shape their pain experiences (Bosma et al., 2024). When clinicians are not adequately prepared to address these factors, trauma-related contributors to pain may remain unrecognized, limiting the effectiveness of otherwise comprehensive treatment approaches (Gerber et al., 2024).

Improving clinicians’ understanding of the neurobiological and psychological impacts of trauma is therefore a critical component of strengthening chronic pain care. Education on the neurobiology of trauma, including the relationship between stress regulation, fear responses, and physical symptoms, has been shown to increase clinician confidence and support the adoption of trauma-informed care practices (Goldstein et al., 2024). When providers understand how early adversity can influence emotional regulation, stress physiology, and pain processing, they are better positioned to interpret complex pain presentations and engage patients in collaborative treatment planning.

Structured educational initiatives have also shown promise in preparing clinicians to address the complexity of trauma in clinical practice. Training programs that focus on ACE screening, trauma-informed communication, and interdisciplinary collaboration have been associated with improvements in provider knowledge and confidence when responding to trauma-related concerns (Katzman et al., 2025). Integrating this type of training into continuing professional development programs, pain management education, and interdisciplinary team training may help clinicians translate emerging research into everyday practice (Goldstein et al., 2024).

Incorporating trauma-informed education into clinical training may therefore support a more consistent integration of ACE-informed evidence within chronic pain care. Strengthening provider preparedness in this way would help ensure that biopsychosocial approaches to pain management are applied in ways that recognize the influence of trauma and support more responsive, patient-centered care.

Standard ACE Screening for Chronic Pain Patients

While education and training are essential for improving recognition of ACEs in individuals with chronic pain, there must also be mechanisms in place to ensure consistent implementation within clinical practice.

In other areas of trauma-informed care, standardized screening tools such as the Global Psychotrauma Screen (GPS) and the Structured Trauma-Related Experiences and Symptoms (STRESS) are screening tools already used in Canada to identify a broad range of trauma-related psychological concerns such as PTSD (Frewen et al., 2021). Given the demonstrated applicability of these tools within trauma-informed research and practice (Grasso et al., 2015), there is a strong rationale for adopting a similar standardized framework for ACEs. However, current evidence regarding the benefits, challenges, and potential harms of ACE screening in Canadian healthcare and other settings remains limited due to its lack of implementation in relation to Chronic Pain care and in general. As such, further investigation into appropriate screening tools and their role in clinical practice is necessary to support effective and ethical implementation (Austin et al., 2024).

In retrospect, screening templates such as ACE-Q and CDC-Kaiser Permanente ACE scale (also known as the ACE study Questionnaire are widely used tools designed to measure types of Adverse childhood experiences. The ACE-Q assessed two primary domains: abuse/neglect and household dysfunction, capturing experiences such as emotional, physical, and sexual abuse, as well as exposure to family related illnesses and incarcerations (Zarse et al., 2019).

Similarly, the CDC-Kaiser Permanente ACE scale has demonstrated strong psychometric properties including good test reliability and is considered the most robustly evaluated tool measuring (Petruccelli et al., 2019). Across multiple studies, including the original ACE study, this questionnaire has received some positive psychometric evaluation to further support its validity and widespread use (Mosler et al., 2025).

Importantly, ACE screening has also been shown to be feasible in primary care settings, with participants reporting minimal distress during administration, suggesting its integration into clinical workflows is both acceptable and practical (Inch et al., 2025). Surrounding the context of chronic pain care, this is particularly relevant as incorporating ACE screening can support a more comprehensive biopsychosocial approach to treatment by identifying underlying trauma that may contribute to pain persistence and treatment responsiveness.

Conclusion

This review demonstrates a consistent association between ACEs and chronic pain across diverse populations and study designs. Mechanistic evidence emphasizes how early-life adversity disrupts neurobiological pathways, stress regulation, and emotional processing, thereby increasing vulnerability to persistent pain. Although trauma-informed and biopsychosocial interventions show strong potential to improve both pain-related and psychosocial outcomes, their implementation remains inconsistent. Similarly, education and training in ACE-informed care are limited, and measurement variability continues to hinder effective clinical translation.

Collectively, these findings demonstrate a clear translational gap, despite substantial evidence supporting the integration of trauma-informed principles into chronic pain management. Inconsistent ACE measurement, limited provider preparedness, and the absence of standardized, interdisciplinary frameworks continue to impede widespread adoption. Importantly, chronic pain management requires coordinated, interdisciplinary care teams, yet trauma-informed approaches are not consistently embedded across these settings.

Bridging this gap will require coordinated efforts across research, policy, and clinical practice. From a research perspective, there is a need to adopt standardized tools with clearly defined scoring procedures, tiered classifications, and administration protocols. At the clinical level, expanding provider training in trauma-informed care is essential to ensure that healthcare professionals can recognize, assess, and appropriately respond to ACE-related factors within pain presentations. This training must be integrated across interdisciplinary teams to support consistent, patient-centered care. At the policy level, the development of national standards is necessary to establish a unified foundation for trauma-informed chronic pain management, embedding these approaches within existing frameworks such as the Canadian Pain Task Force’s Action Plan for Pain in Canada, alongside structured educational initiatives. Finally, the routine implementation of validated screening tools in clinics, including the ACE-Q and the CDC-Kaiser Permanente ACE scale, is critical for identifying underlying trauma that contributes to pain persistence. Together, these recommendations provide a pathway toward more equitable, coordinated, and trauma-informed chronic pain care in Canada.

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