



Published in final edited form as:

Child Care Health Dev. 2025 January ; 51(1): e70016. doi:10.1111/cch.70016.

ADHD (Attention-Deficit Hyperactivity Disorder) Symptoms Are Associated With Chronic Pain Interference: Results From a Prospective Cohort Study

Patrick C. M. Brown^{1,4}, Sarah W. Feldstein Ewing², Anna C. Wilson³

¹School of Medicine, Oregon Health & Science University, Portland, Oregon, USA

²Department of Psychiatry, University of Connecticut School of Medicine, Farmington, Connecticut, USA

³Department of Pediatrics, Institute on Development and Disability, Oregon Health & Science University, Portland, Oregon, USA

⁴Department of Surgery, University of North Carolina Hospitals, Chapel Hill, North Carolina, USA

Abstract

Background: Despite a known relationship between attention-deficit hyperactivity disorder (ADHD) and chronic pain, the association between ADHD symptoms and pain interference has not been prospectively investigated.

Methods: Young adults were recruited following receipt of a prescription opioid from ambulatory surgery clinics, outpatient clinics and emergency departments as part of a larger study. Participants completed measures of ADHD symptoms, depression, pain catastrophizing, adverse childhood experiences and pain interference at enrolment and 6 months later. Logistic regression was used to examine the relationship between ADHD symptoms and covariates on moderate-to-severe pain interference at 6 months.

Results: Participants were 116 young adults who completed the baseline ADHD symptoms measure; 71 completed the 6-month timepoint. Moderate-to-severe pain interference was present among 89.7% at baseline and 52.3% at 6 months. ADHD symptoms (OR [odds ratio] = 1.42, 95% CI [confidence interval] = 1.05–1.93), depression (OR = 1.08, 95% CI = 1.02–1.14) and pain catastrophizing (OR = 1.06, 95% CI = 1.01–1.12) were significantly associated with odds of

Correspondence: Anna C. Wilson (longann@ohsu.edu).

Author Contributions

Patrick C. M. Brown: conceptualization, formal analysis, writing—original draft, writing—review and editing, methodology. **Sarah W. Feldstein Ewing:** conceptualization, funding acquisition, resources, supervision, writing—review and editing, methodology. **Anna C. Wilson:** conceptualization, data curation, funding acquisition, resources, writing—review and editing, project administration, supervision, methodology.

Ethics Statement

The study was conducted according to the guidelines of the Declaration of Helsinki, and approved by the Institutional Review Board (or Ethics Committee) of Oregon Health & Science University (protocol number STUDY00017466).

Consent

Informed consent was obtained from all subjects involved in the study.

Conflicts of Interest

The authors declare no conflicts of interest.

moderate-to-severe pain interference at 6 months. In multivariable regression, ADHD symptoms (OR = 1.52, 95% CI = 1.09–2.12) and pain catastrophizing (OR = 1.07, 95% CI = 1.01–1.13) were significant predictors of moderate-to-severe pain interference at 6 months.

Conclusions: Participants with more ADHD symptoms were at greater risk for chronic pain interference. This is consistent with prior studies examining the role of attention in chronic pain. Individuals with ADHD symptoms may be at greater risk for chronic pain and future research should investigate tailored prevention and treatment approaches.

Keywords

ADHD; attention; chronic; pain; pain interference

1 | Introduction

Chronic pain, the most prevalent cause of global disability and a major precipitant of the United States opioid overdose crisis, is a leading public health concern (GBD 2017 Disease and Injury Incidence and Prevalence Collaborators 2018). Though the prevalence of chronic pain increases with age, it is common among young adults, those aged 18 to 29 years (estimates typically range from 5%–30%), and a number of biopsychosocial factors can cause chronic pain to worsen over time, making the negative impact lifelong (Dahlhamer et al. 2018; Brown et al. 2021; Arendt-Nielsen et al. 2018; Woolf 2011). Therefore, the prediction and prevention of chronic pain in the developmental period of young adulthood hold enormous promise for long-term societal benefit.

Psychosocial problems, including depression, pain catastrophizing and social support, are consistently found to be reliable predictors of transition to chronic pain following an injury or surgery (Mills, Nicolson, and Smith 2019; Edwards et al. 2016; Hruschak and Cochran 2018). Interdisciplinary, multimodal approaches that consider pain in the psychosocial context are central to the successful treatment of chronic pain (Nijs et al. 2019; Flynn 2020; Cheatle 2016). Psychotherapeutic interventions employed in these approaches such as cognitive behavioural therapy (CBT) skills and mindfulness focus on modifying attention towards and appraisal of pain. Evidence suggests that people with chronic pain exhibit selective attention towards pain-related stimuli (Todd et al. 2018; Broadbent, Liossi, and Schoth 2021). This selective attention is closely linked to pain catastrophizing, an important risk factor for poor pain outcomes, which comprises rumination, magnification and helplessness related to pain (Ranjbar et al. 2020; Lee et al. 2018). Pain catastrophizing is suspected to increase attentional focus on painful or pain-related stimuli and is increased in states of diminished attentional control such as sleep deprivation (Gerhart et al. 2017; Wlad and Nilsson 2017).

Despite a clear role for attention in shaping pain experience, little is known about the role of attentional capacity in the persistence of pain. The intersection between ADHD and chronic pain has been identified as a clinically important and underresearched area (Wlad and Nilsson 2017). The increased risk of chronic pain for children with ADHD may begin in childhood; a recent review demonstrates that ADHD co-occurs with a range of chronic pain conditions in youth (Battison et al. 2023). ADHD is consistently associated with paediatric

migraine, with a meta-analysis of mostly adolescent samples demonstrating 32% increased odds of migraine among subjects with ADHD compared to those without ADHD (Salem et al. 2018). Childhood, but not adult, ADHD symptoms are significantly associated with fibromyalgia impact scores among adult women with fibromyalgia (Karas et al. 2020). Among the general population, adults with elevated ADHD symptoms have increased odds of high levels of pain interference (the degree to which pain interferes with life enjoyment and activities across numerous domains), adjusted for co-occurring psychiatric conditions (Stickley et al. 2016). Among adult women, ADHD is associated with three times the prevalence of chronic pain when compared with women without ADHD (Fuller-Thomson, Lewis, and Agbeyaka 2016). Among adult women, ADHD is associated with a greater risk of endometriosis than other common psychiatric conditions in sibling-matched analysis (Gao et al. 2020). In a longitudinal cohort of youth with and without ADHD, those with ADHD were at significantly greater risk of chronic single-site and multisite at each timepoint over a 9-year period (Mundal et al. 2023).

Co-occurring deficits in attention are also common in chronic pain populations. People with chronic pain perform worse on sustained attention and attention switching tasks than healthy controls, and fibromyalgia is associated with poorer performance across cognitive domains including attention (Oosterman et al. 2012; Moore et al. 2019; Galvez-Sánchez, Reyes Del Paso, and Duschek 2018). ADHD symptoms are overrepresented in patients with chronic nonspecific lower back pain, with nearly one third demonstrating ADHD symptoms on self-report and observer rating scales (Kasahara et al. 2021).

Although there is mounting evidence for overlap between chronic pain and attention deficits, causality and directionality in these relationships are unclear due to the lack of prospective studies examining the development of chronic pain. Cross-sectional studies are unable to distinguish between ADHD as a risk factor for chronic pain versus ADHD symptoms as a consequence of distraction by painful stimuli (Gatzounis et al. 2018). Co-occurring ADHD may have important treatment implications for pain, and a better mechanistic understanding of how attentional capacity and pain interact is essential for treatment development. The association between ADHD and chronic pain is also of grave concern in the context of prescription opioids for pain, as ADHD co-occurs frequently with substance misuse (van de Glind et al. 2020).

This study aimed to investigate the role of ADHD symptoms in the development of chronic pain interference following an episode of significant, acute pain among young people. Pain interference importantly captures functional impairment and the quality-of-life impact of pain (Karayannis et al. 2017). Research measuring pain interference has identified associations with reduced physical function and increased healthcare utilization. It was hypothesized that greater ADHD symptoms would predict the presence of pain interference at 6-month follow-up, which was considered chronic pain interference.

As several other psychosocial factors have been associated with chronic pain and related disability, we also included measures of depression and adverse childhood events in analyses. Data were collected as part of an ongoing longitudinal cohort study (3R01DA044778–02S1) of young adults recruited following receipt of a prescription opioid

for acute pain in outpatient medical settings (e.g., due to an injury or ambulatory surgery). This prospective design allows ADHD symptoms to be examined as a risk factor for chronic pain interference, and not just a co-occurring condition, while controlling for known psychosocial risk factors.

2 | Methods

2.1 | Participants

Eligible participants (1) were young adults, defined as ages 19 to 26 at enrolment; (2) spoke English fluently; and (3) received a prescription opioid for acute pain in an outpatient medical setting. Potential participants were excluded if they (1) had any chronic pain condition, (2) had cancer in the past 12 months, (3) had a child cognitive impairment or developmental disability impacting their ability to read and write, (4) were admitted to the hospital at the time of prescription opioid receipt or (5) had received another prescription opioid in the last 3 months. Participants were recruited from three clinical settings (emergency department, ambulatory surgery and outpatient clinics) at an academic medical centre in a major metropolitan area (Portland, Oregon, U.S.A.).

Between May 2020 and July 2021, 158 eligible participants were identified; 116 enrolled and completed baseline data collection including the ADHD measure. Of these, 71 completed the pain interference measure at 6-month follow-up.

2.2 | Procedures

IRB approval was obtained for all procedures. Participants were identified through manual chart review and automated electronic medical record alerts and were contacted in the 72 h following receipt of a prescription opioid as part of a larger, ongoing study. Recruitment sources included outpatient surgery, outpatient clinics (primary care, specialty care and dental clinics) and an emergency department. Potential participants were contacted by phone or text by a research assistant. Participants were informed about the nature and details of the study via phone and signed consent forms electronically. Study measures were completed via REDCap (Vanderbilt University, Nashville, USA) (Harris et al. 2009; Harris et al. 2019) shortly after study enrolment, and again 6 months after the baseline assessment. Participants were compensated at each study timepoint, with a total of \$105 received if all study timepoints were completed.

2.3 | Measures

2.3.1 | ADHD Symptoms—Participants completed the six-item Adult ADHD Self-Report Scale (ASRS) Screener (v1.1), which assesses the frequency with which ADHD symptoms are present, ranging from 1 (*never*) to 5 (*very often*) (Kessler et al. 2005). The ASRS Screener is used to clinically screen for ADHD and includes the six most predictive items from the longer ASRS measure (Kessler et al. 2005). Each item has a defined cutoff at which a symptom is considered clinically significant. Total scores (number of ADHD symptoms above the cut-off) range from 0 to 6, and this score was treated as a continuous variable in the analysis after confirming its linearity with the outcome and the absence of multicollinearity and outliers. Total scores greater than 3 indicate that further evaluation for

ADHD is needed. The ASRS Screener was used due to its low response burden and potential for use in time-limited clinical settings; it demonstrates greater sensitivity and specificity than the 18-item ASRS from which it is derived (Kessler et al. 2005). ADHD symptoms were analysed as a continuous variable.

2.3.2 | Depression—Participants completed the PROMIS Depression Short Form, which assesses depression severity and includes eight items rated from 1 (*never*) to 5 (*always*). Raw scores are *T* score standardized to national data ($M = 50$, $SD = 10$) (Pilkonis et al. 2014). Higher scores represent greater depression severity. Depression was analysed as a continuous variable.

2.3.3 | Pain Catastrophizing—Participants completed the Pain Catastrophizing Scale, which assesses subjective magnification and rumination about pain. The measure includes 11 items (two items with low variability were removed from the original measure) rated from 0 (*not at all*) to 4 (*all the time*) (Pielech et al. 2014). Higher scores represent more pain catastrophizing. A score ≥ 15 corresponds to moderate-to-severe pain interference and was considered clinically significant (Pielech et al. 2014). Pain catastrophizing was analysed as a continuous variable.

2.3.4 | Adverse Childhood Experiences (ACEs)—The ACEs questionnaire assesses a history of potentially traumatic experiences in childhood and includes 10 items that are answered ‘Yes’ or ‘No’. An ACEs’ score of 4 or greater is associated with multiple adverse medical and psychological outcomes (Felitti et al. 1998). ACEs was analysed as a continuous variable.

2.3.5 | Pain Interference—Participants completed the PROMIS Pain Interference–Short Form 6b, a six-item questionnaire assessing the interference with daily activities caused by pain in the past 7 days (Cella et al. 2014). Responses range from 1 (*not at all*) to 5 (*very much*). Scores were standardized to national data ($M = 50$, $SD = 10$). A *T* score ≥ 55 corresponds to moderate-to-severe pain interference and was used as the cutoff in this analysis, where the presence of moderate-to-severe pain interference was analysed as a categorical, binary variable (Rothrock, Amtmann, and Cook 2020).

2.4 | Data Analysis

All analyses were conducted in R (R Foundation for Statistical Computing, Vienna, Austria) (R Core Team 2017). Descriptive analyses were performed for participant demographics, baseline psychosocial characteristics and pain interference at baseline and 6 months. Baseline characteristics were compared between participants with and without 6-month follow-up data using independent-measures two-tailed *t* tests and Fisher’s exact tests to ascertain whether participants lost to follow-up differed from those enrolled. One-sample two-tailed *t* tests were performed to compare PROMIS measures to the population mean of 50. A paired-samples two-tailed *t* test was performed to test differences in pain interference at baseline and at 6 months.

Multivariable logistic regression was used to test the association between number of ADHD symptoms at baseline and moderate-to-severe pain interference (*T* score ≥ 55) at 6 months,

reported as an odds ratio (OR), while adjusting for possible confounders of the association. Logistic regression was used to analyse this continuously measured variable because the values were highly zero inflated with over one third of participants reporting no pain interference at 6 months. Possible covariates were identified via literature review of known chronic pain risk factors and investigator hypotheses and included assigned sex at birth, depression, pain catastrophizing, ACEs and baseline pain interference. All covariates were continuous variables except for assigned sex at birth. Covariates with a significant univariate association with the outcome were added to the logistic regression model sequentially and retained if their inclusion changed the beta coefficient (the change in log odds of moderate-to-severe pain interference at 6 months associated with a one-unit increase in the total number of ADHD symptoms) for ADHD symptoms by 10% or greater and did not detract from model fit (defined as increasing the Akaike Information Criterion [AIC] by 2 or more). This method was used rather than a p value-based method in order to focus the model on the factors affecting the relationship of interest. Baseline pain interference was not included in the multivariate model as pain interference was a repeated measure that violated the independence assumption of generalized linear regression. Excluding baseline measures of a study outcome has been shown to be statistically acceptable when the correlation of baseline and follow-up measures is low (Vickers 2001). Scatter plots of included variables were assessed for linearity with the predicted log odds to ensure the final model met the assumptions of logistic regression. Spearman correlation coefficients were calculated for univariable relationships among predictors and between predictors and pain interference at 6 months. The alpha value used for all tests was 0.05.

3 | Results

3.1 | Participant Characteristics

The sample included $N = 116$ young adults who had received a prescription opioid to treat acute pain. Baseline characteristics did not differ significantly between participants with (71/116; 61.2%) and without (45/116; 38.8%) complete PROMIS Pain Interference follow-up data (Table 1). Participant assigned sex at birth was 66% female and 34% male. Mean participant age was 22.2 years ($SD = 2.0$; range = 19–26); 72% of participants were non-Hispanic White, and 13% were Hispanic (Table 1).

Compared with PROMIS reference populations (representative of the United States adult population), participants reported higher levels of depression at baseline (55.5 vs. 50, $p < 0.001$), and pain interference at both baseline (63.0 vs. 50, $p < 0.001$) and 6-month follow-up (52.8 vs. 50, $p = 0.007$). Mean pain interference was significantly lower at 6 months than at baseline (52.9 vs. 63.03, $p < 0.001$). Participants reported high rates of clinically significant ADHD symptoms (a positive result on the ASRS Screener; 32.8%), pain interference (moderate-to-severe; 90.4%), pain catastrophizing (moderate-to-severe; 38.8%) and ACEs (≥ 4 ACEs; 30.2%) (Table 1).

In univariable regressions (Table 2), female assigned sex at birth, ACEs and baseline pain interference were not significantly associated with odds of persistent moderate-to-severe pain interference at 6 months. Number of ADHD symptoms was associated with higher odds of moderate-to-severe pain interference at 6 months ($OR = 1.42$, 95% $CI = 1.05$ – 1.93), as

was PROMIS Depression score (OR = 1.08, 95% CI = 1.02–1.14) and pain catastrophizing score (OR = 1.06, 95% CI = 1.01–1.12).

The final model (Table 2) included main effects for ADHD symptoms (OR = 1.52, 95% CI = 1.09–2.12) and pain catastrophizing (OR = 1.07, 95% CI = 1.01–1.13), which were statistically significant. For each additional ADHD symptom a participant had, their odds of moderate-to-severe pain interference increased by 52%. For each additional point on the pain catastrophizing scale, odds of moderate-to-severe pain interference increased by 7%. ADHD symptoms and pain catastrophizing were weakly associated ($r = 0.052$).

4 | Discussion

These findings demonstrate a previously unreported significant prospective association between ADHD symptoms and the presence of moderate-to-severe pain interference at 6 months following acute pain in young adults receiving medical care. Pain catastrophizing was also a significant predictor. Surprisingly, ACEs, which have previously shown a dose-dependent relationship to chronic pain in both paediatric and adult populations, were not a significant predictor of moderate-to-severe pain interference in this sample (Brown et al. 2018; Groenewald, Wright, and Palermo 2015). In multivariable analyses, only ADHD symptoms and pain catastrophizing predicted moderate-to-severe pain interference over the 6 month window for this sample of young people.

Interestingly, baseline pain interference was not significantly associated with pain interference at 6 months, suggesting that the psychological factors investigated in this study may contribute more to chronic pain and related pain interference than degree of initial injury, consistent with prior studies on traumatic injury (Castillo et al. 2006; Harris et al. 2007).

These results suggest that ADHD symptoms place young adults at risk for chronic pain interference following an acute injury or surgery and precede differences in pain experience. Individuals with ADHD symptoms are likely at greater risk for both pain and opioid prescription throughout adulthood due to their relatively high rate of injury (Brunkhorst-Kanaan et al. 2021). This is consistent with our sample, in which more participants had elevated scores on the ASRS Screener (32.8%) than nontreatment seeking normative cohorts of young adults (17.3%–26.0%) (Chamberlain, Cortese, and Grant 2021). ADHD has already been established as a risk factor for being prescribed opioids and onset of prescription opioid misuse, and chronic pain interference following prescription opioid receipt may be an important mechanism of increased risk of later prescription opioid misuse (Emmerik-van Oortmerssen et al. 2012; Quinn et al. 2018). Further research in this cohort will establish whether chronic pain interference is implicated as a mediator between ADHD symptoms and prescription opioid misuse outcomes in the larger parent study.

ADHD has previously shown a complex and variable relationship with pain sensitivity. In prior studies, youth with ADHD demonstrate mixed abnormalities in pain sensitivity. Bruton et al. (2023) found associations between heightened pain sensitivity and both emotional and conduct problems in this population. In another sample, ADHD severity was associated with

increased pain sensitivity, and severity comorbid conduct disorder was negatively correlated (Northover et al. 2015). One study has found reduced pain perception among youth with ADHD, though this is refuted by the findings of this study and the larger body of literature (Wolff et al. 2016).

The heightened risk for chronic pain interference for youth with greater ADHD symptoms suggests a need for investigation of treatment approaches in this at-risk population. Treatment of ADHD with psychostimulants normalizes pain perception thresholds in both studies showing increased and decreased pain perception among youth with ADHD (Wolff et al. 2016; Treister et al. 2015; Bozkurt and Balta 2023). Northover et al. (2015) found no relationship between pain perception and medication for ADHD but notably required participants to discontinue medication 24 h prior to pain testing. In adults with low back pain, ADHD is associated with poorer treatment outcomes in CBT, a cornerstone of chronic pain (Shimizu et al. 2021). This suggests that a focus on treating underlying ADHD and perhaps tailored approaches to chronic pain may be needed for the treatment of chronic pain individuals with ADHD. This study was not powered to examine the role of medication as only five participants endorsed taking ADHD medication during the study. A prospective study of an ADHD cohort at risk for chronic pain is an important next step to examine the effect of pain and ADHD treatment approaches on the development of chronic pain.

These findings have important clinical and public health implications. They underscore the necessity of early screening for pain interference in young adults with ADHD and suggest that integrating pain management strategies with ADHD treatment could be beneficial. Conversely, the brief ASRS screener could be a valuable tool in the evaluation of young adults with acute pain, especially in settings where opioids are prescribed. Early screening for pain interference in patients with ADHD could lead to interventions that mitigate long-term physical and behavioural disability and improve quality of life. From a public health perspective, ADHD should be treated not only as a neuropsychiatric concern, but an important risk factor for chronic pain and opioid misuse around which preventative strategies can be developed. Educational programmes that increase awareness about the links between ADHD, chronic pain and opioid use among clinicians, patients and caregivers could be pivotal in changing improving outcomes for patients with ADHD.

Although this study has several strengths, limitations of this study include that baseline characteristics were assessed in the acute pain period. Pain experience might influence reporting of ADHD symptoms; the ASRS has shown mixed validity across populations with a range of potentially co-occurring conditions (Daigre Blanco et al. 2009; Carlucci et al. 2017; Weibel et al. 2018). However, baseline ADHD symptoms and baseline pain interference did not predict or correlate well with each in this study, so this is unlikely to be an important source of confounding. Attention was also treated as a unitary construct in this analysis.

The role of attentional capacity is complex, with components having conflicting effects on pain experience (Wauters et al. 2021). Prospective data collection including more nuanced measures of attention will be needed to investigate this possibility. Recent research suggests that insomnia may mediate the relationship between ADHD and pain interference, which

we were unable to investigate in this study but will be an important future direction (Wiwe Lipsker et al. 2018). Finally, much of the data collection in this study occurred in the first year of the COVID-19 pandemic; the psychological impact of the pandemic may have influenced variables in this study. Significant loss to follow-up occurred in our study, with only 71 of 116 completing the pain interference measure at the 6-month timepoint. However, these participants did not differ in characteristics analysed, and follow-up data were treated as missing completely at random.

In sum, these results raise concerns for poor pain outcomes among patients with ADHD symptoms. Conversely, those with few or no symptoms of ADHD may be protected from ongoing pain. The ASRS is a brief measure and may have clinical utility in the assessment of patients with pain.

Acknowledgements

The authors would like to thank Stefani Aleman, MPH, for statistical consultation.

Funding:

This study was supported by the National Institute on Drug Abuse (R01DA044778 and 3R01DA044778-02S1) and the National Center for Advancing Translational Sciences (UL1TR002369).

Data Availability Statement

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

References

- Arendt-Nielsen L, Morlion B, Perrot S, et al. 2018. "Assessment and Manifestation of Central Sensitisation Across Different Chronic Pain Conditions." *European Journal of Pain* Lond Engl. 22, no. 2: 216–241. 10.1002/ejp.1140.
- Battison EAJ, Brown PCM, Holley AL, and Wilson AC. 2023. "Associations Between Chronic Pain and Attention-Deficit Hyperactivity Disorder (ADHD) in Youth: A Scoping Review." *Child Basel Switz* 10, no. 1: 142. 10.3390/children10010142.
- Bozkurt A, and Balta S. 2023. "The Effect of Methylphenidate on Pain Perception Thresholds in Children With Attention Deficit Hyperactivity Disorder." *Child and Adolescent Psychiatry and Mental Health* 17, no. 1: 118. 10.1186/s13034-023-00667-y. [PubMed: 37833816]
- Broadbent P, Lioffi C, and Schoth DE. 2021. "Attentional Bias to Somatosensory Stimuli in Chronic Pain Patients: A Systematic Review and Meta-Analysis." *Pain* 162, no. 2: 332–352. 10.1097/j.pain.0000000000002040. [PubMed: 32833792]
- Brown D, Schenk S, Genent D, Zernikow B, and Wager J. 2021. "A Scoping Review of Chronic Pain in Emerging Adults." *PAIN Reports* 6, no. 1: e920. 10.1097/PR9.0000000000000920. [PubMed: 34712883]
- Brown RC, Plener PL, Braehler E, Fegert JM, and Huber-Lang M. 2018. "Associations of Adverse Childhood Experiences and Bullying on Physical Pain in the General Population of Germany." *Journal of Pain Research* 11: 3099–3108. 10.2147/JPR.S169135. [PubMed: 30584352]
- Brunkhorst-Kanaan N, Libutzki B, Reif A, Larsson H, McNeill RV, and Kittel-Schneider S. 2021. "ADHD and Accidents Over the Life Span—A Systematic Review." *Neuroscience and Biobehavioral Reviews* 125: 582–591. 10.1016/j.neubiorev.2021.02.002. [PubMed: 33582234]
- Bruton AM, Senders A, Tost G, et al. 2023. "Pain Sensitivity and Perceptual Sensitivity Are Associated With Severity of Emotional Dysregulation in Children With ADHD: A Cross-

- Sectional Analysis Using the Temperament in Middle Childhood Questionnaire.” *Disability and Rehabilitation* 45, no. 5: 848–856. 10.1080/09638288.2022.2043946. [PubMed: 35271401]
- Carlucci S, Ivanova I, Bissada H, and Tasca GA. 2017. “Validity and Reliability of the Attention Deficit Hyperactivity Disorder Self-Report Scale (ASRS-v1.1) in a Clinical Sample With Eating Disorders.” *Eating Behaviors* 26: 148–154. 10.1016/j.eatbeh.2017.03.010. [PubMed: 28390269]
- Castillo RC, MacKenzie EJ, Wegener ST, and Bosse MJ. 2006. “Prevalence of Chronic Pain Seven Years Following Limb Threatening Lower Extremity Trauma.” *Pain* 124, no. 3: 321–329. 10.1016/j.pain.2006.04.020. [PubMed: 16781066]
- Cella D, Choi S, Garcia S, et al. 2014. “Setting Standards for Severity of Common Symptoms in Oncology Using the PROMIS Item Banks and Expert Judgment.” *Quality of Life Research: an International Journal of Quality of Life Aspects of Treatment, Care and Rehabilitation* 23, no. 10: 2651–2661. 10.1007/s11136-014-0732-6. [PubMed: 24938431]
- Chamberlain SR, Cortese S, and Grant JE. 2021. “Screening for Adult ADHD Using Brief Rating Tools: What Can We Conclude From a Positive Screen? Some Caveats.” *Comprehensive Psychiatry* 106: 152224. 10.1016/j.comppsych.2021.152224. [PubMed: 33581449]
- Cheattle MD 2016. “Biopsychosocial Approach to Assessing and Managing Patients With Chronic Pain.” *Medical Clinics of North America* 100, no. 1: 43–53. 10.1016/j.mcna.2015.08.007. [PubMed: 26614718]
- Dahlhamer J, Lucas J, Zelaya C, et al. 2018. “Prevalence of Chronic Pain and High-Impact Chronic Pain Among Adults—United States, 2016.” *MMWR. Morbidity and Mortality Weekly Report* 67, no. 36: 1001–1006. 10.15585/mmwr.mm6736a2. [PubMed: 30212442]
- Daigre Blanco C, Ramos-Quiroga JA, Valero S, et al. 2009. “Adult ADHD Self-Report Scale (ASRS-v1.1) Symptom Checklist in Patients With Substance use Disorders.” *Actas Españolas de Psiquiatría* 37, no. 6: 299–305. [PubMed: 20066581]
- Edwards RR, Dworkin RH, Sullivan MD, Turk DC, and Wasan AD. 2016. “The Role of Psychosocial Processes in the Development and Maintenance of Chronic Pain.” *Journal of Pain* 17, no. 9 Suppl: T70–T92. 10.1016/j.jpain.2016.01.001. [PubMed: 27586832]
- van Emmerik-van Oortmerssen K, van de Glind G, van den Brink W, et al. 2012. “Prevalence of Attention-Deficit Hyperactivity Disorder in Substance use Disorder Patients: A Meta-Analysis and Meta-Regression Analysis.” *Drug and Alcohol Dependence* 122, no. 1: 11–19. 10.1016/j.drugalcdep.2011.12.007. [PubMed: 22209385]
- Felitti VJ, Anda RF, Nordenberg D, et al. 1998. “Relationship of Childhood Abuse and Household Dysfunction to Many of the Leading Causes of Death in Adults. The Adverse Childhood Experiences (ACE) Study.” *American Journal of Preventive Medicine* 14, no. 4: 245–258. 10.1016/s0749-3797(98)00017-8. [PubMed: 9635069]
- Flynn DM 2020. “Chronic Musculoskeletal Pain: Nonpharmacologic, Noninvasive Treatments.” *American Family Physician* 102, no. 8: 465–477. [PubMed: 33064421]
- Fuller-Thomson E, Lewis DA, and Agbeyaka SK. 2016. “Attention-Deficit/Hyperactivity Disorder Casts a Long Shadow: Findings From a Population-Based Study of Adult Women With Self-Reported ADHD.” *Child: Care, Health and Development* 42, no. 6: 918–927. [PubMed: 27439337]
- Galvez-Sánchez CM, Reyes Del Paso GA, and Duschek S. 2018. “Cognitive Impairments in Fibromyalgia Syndrome: Associations With Positive and Negative Affect, Alexithymia, Pain Catastrophizing and Self-Esteem.” *Frontiers in Psychology* 9: 377. 10.3389/fpsyg.2018.00377. [PubMed: 29623059]
- Gao M, Koupil I, Sjöqvist H, et al. 2020. “Psychiatric Comorbidity Among Women With Endometriosis: Nationwide Cohort Study in Sweden.” *American Journal of Obstetrics and Gynecology* 223, no. 3: 415. e1–415.e16. 10.1016/j.ajog.2020.02.033.
- Gatzounis R, Schrooten MGS, Crombez G, and Vlaeyen JWS. 2018. “Activity Interruptions by Pain Impair Activity Resumption, But Not More Than Activity Interruptions by Other Stimuli: An Experimental Investigation.” *Pain* 159, no. 2: 351–358. 10.1097/j.pain.0000000000001079. [PubMed: 28968344]
- GBD 2017 Disease and Injury Incidence and Prevalence Collaborators. 2018. “Global, Regional, and National Incidence, Prevalence, and Years Lived With Disability for 354 Diseases and Injuries

- for 195 Countries and Territories, 1990–2017: A Systematic Analysis for the Global Burden of Disease Study 2017.” *Lancet* 392, no. 10159: 1789–1858. 10.1016/S0140-6736(18)32279-7. [PubMed: 30496104]
- Gerhart JI, Burns JW, Post KM, et al. 2017. “Relationships Between Sleep Quality and Pain-Related Factors for People With Chronic low Back Pain: Tests of Reciprocal and Time of day Effects.” *Annals of Behavioral Medicine, the Society of Behavioral Medicine’s* 51, no. 3: 365–375. 10.1007/s12160-016-9860-2.
- Groenewald CB, Wright DR, and Palermo TM. 2015. “Health Care Expenditures Associated With Pediatric Pain-Related Conditions in the United States.” *Pain* 156, no. 5: 951–957. [PubMed: 25734992]
- Harris IA, Young JM, Rae H, Jalaludin BB, and Solomon MJ. 2007. “Factors Associated With Back Pain After Physical Injury: A Survey of Consecutive Major Trauma Patients.” *Spine* 32, no. 14: 1561–1565. 10.1097/BRS.0b013e318067dce8. [PubMed: 17572628]
- Harris PA, Taylor R, Minor BL, et al. 2019. “The REDCap Consortium: Building an International Community of Software Platform Partners.” *Journal of Biomedical Informatics* 95: 103208. 10.1016/j.jbi.2019.103208. [PubMed: 31078660]
- Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, and Conde JG. 2009. “Research Electronic Data Capture (REDCap)—A Metadata-Driven Methodology and Workflow Process for Providing Translational Research Informatics Support.” *Journal of Biomedical Informatics* 42, no. 2: 377–381. 10.1016/j.jbi.2008.08.010. [PubMed: 18929686]
- Hruschak V, and Cochran G. 2018. “Psychosocial Predictors in the Transition From Acute to Chronic Pain: A Systematic Review.” *Psychology, Health & Medicine* 23, no. 10: 1151–1167. 10.1080/13548506.2018.1446097.
- Karas H, Cetingok H, Iliser R, Carpar E, and Kaser M. 2020. “Childhood and Adult Attention Deficit Hyperactivity Disorder Symptoms in Fibromyalgia: Associations With Depression, Anxiety and Disease Impact.” *International Journal of Psychiatry in Clinical Practice* 24, no. 3: 257–263. [PubMed: 32401570]
- Karayannis NV, Sturgeon JA, Chih-Kao M, Cooley C, and Mackey SC. 2017. “Pain Interference and Physical Function Demonstrate Poor Longitudinal Association in People Living With Pain: A PROMIS Investigation.” *Pain* 158, no. 6: 1063–1068. 10.1097/j.pain.0000000000000881. [PubMed: 28221284]
- Kasahara S, Niwa SI, Matsudaira K, et al. 2021. “High Attention-Deficit/Hyperactivity Disorder Scale Scores Among Patients With Persistent Chronic Nonspecific low Back Pain.” *Pain Physician* 24, no. 3: E299–E307. [PubMed: 33988951]
- Kessler RC, Adler L, Ames M, et al. 2005. “The World Health Organization Adult ADHD Self-Report Scale (ASRS): A Short Screening Scale for use in the General Population.” *Psychological Medicine* 35, no. 2: 245–256. 10.1017/s0033291704002892. [PubMed: 15841682]
- Lee JE, Kim SH, Shin SK, Wachholtz A, and Lee JH. 2018. “Attentional Engagement for Pain-Related Information Among Individuals With Chronic Pain: The Role of Pain Catastrophizing.” *Pain Research & Management* 2018: 6038406–6038409. [PubMed: 30631387]
- Mills SEE, Nicolson KP, and Smith BH. 2019. “Chronic Pain: A Review of Its Epidemiology and Associated Factors in Population-Based Studies.” *British Journal of Anaesthesia* 123, no. 2: e273–e283. 10.1016/j.bja.2019.03.023. [PubMed: 31079836]
- Moore DJ, Meints SM, Lazaridou A, et al. 2019. “The Effect of Induced and Chronic Pain on Attention.” *Journal of Pain* 20, no. 11: 1353–1361. 10.1016/j.jpain.2019.05.004. [PubMed: 31077797]
- Mundal I, Schei J, Lydersen S, Thomsen PH, Nøvik TS, and Kvitland LR. 2023. “Prevalence of Chronic and Multisite Pain in Adolescents and Young Adults With ADHD: A Comparative Study Between Clinical and General Population Samples (The HUNT Study).” *European Child & Adolescent Psychiatry* 29: 1433–1442. 10.1007/s00787-023-02249-x.
- Nijs J, Leysen L, Vanlauwe J, et al. 2019. “Treatment of Central Sensitization in Patients With Chronic Pain: Time for Change?” *Expert Opinion on Pharmacotherapy* 20, no. 16: 1961–1970. 10.1080/14656566.2019.1647166. [PubMed: 31355689]

- Northover C, Thapar A, Langley K, and van Goozen SHM. 2015. "Pain Sensitivity in Adolescent Males With Attention-Deficit/Hyperactivity Disorder: Testing for Associations With Conduct Disorder and Callous and Unemotional Traits." *PLoS ONE* 10, no. 7: e0134417. 10.1371/journal.pone.0134417. [PubMed: 26225935]
- Oosterman JM, Derksen LC, van Wijck AJ, Kessels RP, and Veldhuijzen DS. 2012. "Executive and Attentional Functions in Chronic Pain: Does Performance Decrease With Increasing Task Load?" *Pain Research and Management* 17, no. 3: 159–165. [PubMed: 22606680]
- Pielech M, Ryan M, Logan D, Kaczynski K, White MT, and Simons LE. 2014. "Pain Catastrophizing in Children With Chronic Pain and Their Parents: Proposed Clinical Reference Points and Reexamination of the Pain Catastrophizing Scale Measure." *Pain* 155, no. 11: 2360–2367. 10.1016/j.pain.2014.08.035. [PubMed: 25180013]
- Pilkonis PA, Yu L, Dodds NE, Johnston KL, Maihoefer CC, and Lawrence SM. 2014. "Validation of the Depression Item Bank From the Patient-Reported Outcomes Measurement Information System (PROMIS®) in a Three-Month Observational Study." *Journal of Psychiatric Research* 56: 112–119. 10.1016/j.jpsychires.2014.05.010. [PubMed: 24931848]
- Quinn PD, Hur K, Chang Z, et al. 2018. "Association of Mental Health Conditions and Treatments With Long-Term Opioid Analgesic Receipt Among Adolescents." *JAMA Pediatrics* 172, no. 5: 423–430. 10.1001/jamapediatrics.2017.5641. [PubMed: 29532067]
- R Core Team. 2017. "R: A Language and Environment for Statistical Computing." Published Online. <https://www.R-project.org/>.
- Ranjbar S, Mazidi M, Sharpe L, Dehghani M, and Khatibi A. 2020. "Attentional Control Moderates the Relationship Between Pain Catastrophizing and Selective Attention to Pain Faces on the Antisaccade Task." *Scientific Reports* 10: 10.1038/s41598-020-69910-2. [PubMed: 32001736]
- Rothrock NE, Amtmann D, and Cook KF. 2020. "Development and Validation of an Interpretive Guide for PROMIS Scores." *Journal of Patient-Reported Outcomes* 4: 4. 10.1186/s41687-020-0181-7. [PubMed: 31933005]
- Salem H, Vivas D, Cao F, Kazimi IF, Teixeira AL, and Zeni CP. 2018. "ADHD Is Associated With Migraine: A Systematic Review and Meta-Analysis." *European Child & Adolescent Psychiatry* 27, no. 3: 267–277. [PubMed: 28905127]
- Shimizu K, Inage K, Orita S, et al. 2021. "Background Factors for Chronic low Back Pain Resistant to Cognitive Behavioral Therapy." *Scientific Reports* 11, no. 1: 8227. 10.1038/s41598-021-87239-2. [PubMed: 33859240]
- Stickley A, Koyanagi A, Takahashi H, and Kamio Y. 2016. "ADHD Symptoms and Pain Among Adults in England." *Psychiatry Research* 246: 326–331. [PubMed: 27750114]
- Todd J, van Ryckeghem DML, Sharpe L, and Crombez G. 2018. "Attentional Bias to Pain-Related Information: A Meta-Analysis of Dot-Probe Studies." *Health Psychology Review* 12, no. 4: 419–436. 10.1080/17437199.2018.1521729. [PubMed: 30205757]
- Treister R, Eisenberg E, Demeter N, and Pud D. 2015. "Alterations in Pain Response Are Partially Reversed by Methylphenidate (Ritalin) in Adults With Attention Deficit Hyperactivity Disorder (ADHD)." *Pain Practice: the Official Journal of World Institute of Pain* 15, no. 1: 4–11. 10.1111/papr.12129. [PubMed: 24134430]
- van de Glind G, Brynte C, Skutle A, et al. 2020. "The International Collaboration on ADHD and Substance Abuse (ICASA): Mission, Results, and Future Activities." *European Addiction Research* 26, no. 4–5: 173–178. 10.1159/000508870. [PubMed: 32599579]
- Vickers AJ. 2001. "The use of Percentage Change From Baseline as an Outcome in a Controlled Trial Is Statistically Inefficient: A Simulation Study." *BMC Medical Research Methodology* 1, no. 1: 1–4. 10.1186/1471-2288-1-6. [PubMed: 11231885]
- Wauters A, Noel M, Van Ryckeghem DML, Soltani S, and Vervoort T. 2021. "The Moderating Role of Attention Control in the Relationship Between Pain Catastrophizing and Negatively-Biased Pain Memories in Youth With Chronic Pain." *Journal of Pain* 11: 1303–1314. 10.1016/j.jpain.2021.04.010.
- Weibel S, Nicastro R, Prada P, et al. 2018. "Screening for Attention-Deficit/Hyperactivity Disorder in Borderline Personality Disorder." *Journal of Affective Disorders* 226: 85–91. 10.1016/j.jad.2017.09.027. [PubMed: 28964997]

- Wiwe Lipsker C, von Heijne M, Bolte S, and Wicksell RK. 2018. "A Case Report and Literature Review of Autism and Attention Deficit Hyperactivity Disorder in Paediatric Chronic Pain." *Acta Paediatrica* 107, no. 5: 753–758. [PubMed: 29341240]
- Wlad M, and Nilsson B. 2017. "Chronic Pain and ADHD—An Unexplored Connection." *Läkartidningen* 114: ER6D. <https://europepmc.org/article/med/28787081>.
- Wolff N, Rubia K, Knopf H, et al. 2016. "Reduced Pain Perception in Children and Adolescents With ADHD Is Normalized by Methylphenidate." *Child and Adolescent Psychiatry and Mental Health* 10: 10. 10.1186/s13034-016-0112-9. [PubMed: 27200107]
- Woolf CJ 2011. "Central Sensitization: Implications for the Diagnosis and Treatment of Pain." *Pain* 152, no. 3 Suppl: S2–S15. 10.1016/j.pain.2010.09.030. [PubMed: 20961685]

Summary

- ADHD symptoms significantly correlate with chronic pain interference, highlighting the need for targeted management strategies.
- Co-occurring psychological characteristics such as depression and pain catastrophizing are also associated with increased odds of moderate-to-severe pain interference.
- The study supports previous research emphasizing attention's role in chronic pain, suggesting individuals with ADHD are at higher risk.

TABLE 1 |

Participant characteristics.

Characteristic	Enrolled (N = 116)	Completed 6-month timepoint (N = 71)
Assigned female at birth, <i>n</i> (%)	76 (65.5)	46 (64.8)
Age (years, Mean ± SD)	22 ± 2	22 ± 2
Self-reported race-ethnicity, <i>n</i> (%)		
Non-Hispanic White	84 (72.4)	50 (70.4)
Hispanic	15 (12.9)	11 (15.5)
Asian or Pacific Islander	6 (5.2)	4 (5.6)
African American/Black	5 (4.3)	3 (4.2)
Native American	4 (3.4)	3 (4.2)
Pacific Islander	1 (0.9)	0 (0)
Middle Eastern	1 (0.9)	0 (0)
Reason for opioid prescription, <i>n</i> (%)		
Outpatient surgery or procedure	98 (84.5)	61 (85.9)
Painful medical condition (excluding injury)	12 (10.3)	6 (8.4)
Injury	6 (5.2)	4 (5.6)
Prior diagnosis of ADHD, <i>n</i> (%)	13 (11.2)	10 (14.1)
Prescribed medication for ADHD, <i>n</i> (%)	5 (4.3)	5 (7.0)
Psychosocial measures, mean ± SD		
Baseline ADHD symptoms	2.7 ± 1.7	2.4 ± 1.7
Baseline PROMIS depression	55.5 ± 8.7**	54.8 ± 9.0**
Baseline pain catastrophizing	13.3 ± 10.2	13.15 ± 10.5
Baseline ACEs	2.6 ± 2.6	2.6 ± 2.5
Baseline PROMIS pain interference	63.0 ± 7.8**	63.11 ± 6.7**

* Significantly different from PROMIS population mean (*p* < 0.05).

** Significantly different from PROMIS population mean (*p* < 0.001).

TABLE 2 |
Univariable and multivariable logistic regression models predicting 6-month pain interference.

Univariable associations	Odds ratio	95% CI	p value	Correlation with 6-month pain interference
Assigned female sex at birth	2.13	[0.79, 5.75]	0.135	0.199
ADHD symptoms	1.42	[1.05, 1.93]	0.024 *	0.332
Depression	1.08	[1.02, 1.14]	0.013 *	0.343
Pain catastrophizing	1.06	[1.01, 1.12]	0.025 *	0.325
Adverse childhood experiences	1.07	[0.88, 1.29]	0.513	0.093
Pain interference (at baseline)	1.05	[0.97, 1.13]	0.198	0.199

Multivariable associations (final model)	Odds ratio	95% CI	p value
ADHD symptoms	1.52	[1.09, 2.12]	0.014 *
Pain catastrophizing	1.07	[1.01, 1.13]	0.014 *

* Statistically significant ($p < 0.05$).