Neuroethics (2022) 15:21
https://doi.org/10.1007/s12152-022-09499-7

ORIGINAL PAPER

Identifying the Presence of Ethics Concepts in Chronic Pain Research: A Scoping Review of Neuroscience Journals

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Received: 10 September 2021 / Accepted: 2 June 2022
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Abstract

Background Chronic pain is a pervasive and invisible condition which affects people in a myriad of ways including but not limited to their quality of life, autonomy, mental and physical health, social mobility, and productivity. There are many ethical implications of neuroscience research on chronic pain, given its potential to reduce suffering and improve the lived experience of people in pain. While a growing body of research studies the etiology, neurophysiology, and management of chronic pain, it is unknown to what degree neuroscience research in this area engages with relevant ethics concepts.

Aim To explore the presence of ethics concepts in empirical chronic pain neuroscience literature to advance knowledge regarding the ethics of chronic pain management.

Methods We conducted a hybrid bibliometric analysis and scoping review of chronic pain neuroscience articles published between 1999 and 2021 to identify the presence of ethics concepts. We selected articles from the top, middle, and bottom 20 neuroscience journals ranked by Impact Factor. We conducted a database search of Web of Science and a hand-search using PubMed, Google Scholar, and the reference lists of included articles.

Findings Our database search yielded 2779 results from which 46 articles met inclusion criteria. An additional 13 articles were hand-retrieved using PubMed and Google Scholar in accordance with the inclusion criteria, totaling 59 articles. We identified four main ethics themes in our analysis: 1) Quality of Life (n = 46), 2) Autonomy (n = 5), 3) Transparency

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s12152-022-09499-7.

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Published online: 14 June 2022

(n = 4), and 4) Beneficence and Non-Maleficence (n = 4).

Conclusion Most neuroscience papers do not include a discussion of ethics related to chronic pain conditions. Those that do tend to merely state rather than define or contextualize a particular ethics concept. Given the potential ethical implications of neuroscience research for people living with chronic pain, we argue that to maximize its public health benefit, neuroscience researchers should consider the ethical relevance of their work within their scientific publications. This may generate further ethical reflection within the field, to improve pain management.

Keywords Chronic Pain · Neuroscience · Scoping Review · Neuroethics · Bibliometric Analysis

Introduction

Chronic pain is a diverse set of conditions and can be extremely debilitating. It affects at least 35% of the global population, and almost 19% of Canadian adults [1–6]. In contrast to acute pain, chronic pain is typically characterized by pain that persists for 3 months or longer and extends beyond the expected healing period [3, 7]. It can be caused by many conditions including fibromyalgia, migraines and headaches, rheumatoid arthritis, spinal injury, and vulvodynia [8, 9]. Chronic pain can affect every dimension of an individual's life, including their family responsibilities, social life, well-being, mental health, sleeping habits, livelihood, and can increase the likelihood of premature mortality [10–13]. Chronic pain is strongly correlated with mental ill health such as anxiety and depression [6].

Chronic pain inflicts a significant economic toll. In the United States, chronic pain costs between $560 and $635 billion per year, which is more than heart disease, diabetes, and cancer combined [6]. In Canada, chronic pain exerts an annual economic burden of $7.2 billion [14, 15]. Chronic pain represents one of the world's largest and most pernicious disease burdens to not only the individual, but also their loved ones and their broader communities.

Many dimensions of chronic pain are difficult to capture, and they evade attempts of objectification and quantification due to its invisible and subjective nature [3]. Self-reporting, typically using a standardized questionnaire, is generally used to assess pain in medical and legal contexts. Recent findings from neuroimaging research using fMRI (functional magnetic resonance imaging) show potential in identifying neurobiological contributions to chronic pain, and some researchers are attempting to measure pain objectively using brain-based biomarkers [15–17]. Albeit controversial, and presently an immature area of research, a brain-based pain biomarker system may offer people living with chronic pain an objective representation of their subjective experience, an experience often met by skepticism from others [18, 19]. The developments in the neuroscience of chronic pain have prompted a host of ethical questions regarding the use of these technologies. Recent scholarship has identified autonomy, privacy, identity, transparency, and distributive justice as some of the key ethical dimensions that must be addressed throughout the development of these technologies and their potential integration into clinical practice [17]. Scholars argue that these ethics concepts must be situated with the context of other ethical dimensions of chronic pain, including racial inequities in chronic pain prevalence and treatment [20], the declaration of pain treatment as a human right [21], the stigma surrounding opioid use for chronic pain [22], and the marginalization of individuals living with disabilities related to chronic pain [23, 24].

The neuroethics of chronic pain is a nascent area of research, and recent scholarship has provoked a more deliberate investigation of the ethical dimensions of chronic pain [17, 25]. While the neuroscience of pain seeks to elucidate the proximate origins of pain and identify effective pain management strategies, the neuroethics of pain aims to explore the ethical issues that arise from the use of technologies such as fMRI and deep brain stimulation (DBS) [25, 26]. Giordano proposed that neuroethics can provide the meta-ethical foundation for the persistent pain neuroscience of the future [25, 27]. For chronic pain neuroscience, greater attention to the ethical, legal, and social implications (ELSI) of empirical research is important.

In a wide variety of disciplines, scholars have applied knowledge synthesis methodologies such as scoping reviews and bibliometric analyses to understand the presence of certain concepts in a literature or to map the literature regarding a particular topic of interest [28]. Previous bibliometric analyses in neuroethics have identified a paucity of neuroethics

concepts in the neuroscience literature. For example, Burwell, Sample, and Racine [29] conducted a scoping review of brain-computer interfaces (BCI) to identify and characterize the key issues associated with BCI use, finding that there was "lack of practical solutions" to address ethical dilemmas. Garnett and colleagues found that the landscape of neuroscience and neuroethics was "sparsely populated" by articles addressing fMRI in the context of its ELSI [30]. Similarly, Anderson, Mizgalewicz, and Illes found that authors of studies of mental illness using fMRI with human participants tend not to frame the limitations of their studies in ethics terms despite their ethical importance [31]. We, like others, believe this gap in discourse between the empirical and ethical dimensions of persistent pain can potentially be bridged by neuroethics [25, 32].

The primary aim of the current study is to explore whether and to what extent authors of empirical chronic pain neuroscience articles engage with ethical issues in their peer reviewed publications. We focus on empirical neuroscience research specifically, as opposed to the neuroethics literature more broadly, as a response to recent calls to integrate neuroethics in neuroscience [33–35] as well as for neuroethics to be more "integrative, inclusive, and impactful"[35]. To address our study aim, we conducted a hybrid bibliometric scoping review of ethics concepts in empirical chronic pain research in neuroscience journals.

Methods

We applied the framework by Arksey and O'Malley [28] to guide the methodology of this hybrid scoping review and bibliometric analysis. Scoping reviews are a method of literature review in the health and social sciences that conceptually 'maps the field' of a given discipline and situates it within a broader epistemic context [28]. The following five stages constituted our methodology:

Stage 1: Establishing the Research Question

Given the advancements in the neuroscience of chronic pain, which have ethical implications for people living with chronic pain, researchers, and communities, we sought to answer the following question: which ethics concepts are present in chronic pain neuroscience literature?

Articles that met the following criteria were included in our review:

1. Published in a peer-reviewed English-language journal between 1999 and 2021.
2. Focused on chronic pain or explores pain as a sequela to another medical diagnosis.
3. An empirical neuroscience research study conducted on human participants.
4. Mentioned, at least once, the word ethics or an ethics concept (excluding research ethics board (REB) / institutional review board (IRB) approval).

We excluded conference proceedings, abstracts, book chapters, and articles for which the full text was not available in English.

Stage 2: Identifying Relevant Studies

Peer-reviewed articles from the top, middle, and bottom 20 neuroscience journals, ranked by impact factor, were included to sample a representative cross section of chronic pain research in neuroscience literature.

The hand-search [36] was conducted by one team member (MA), in consultation with two other team members (The Ethics of Pain Research, Management, and Policy: A Planning and Knowledge Exchange Meeting and RS), using Google Scholar, PubMed, and the references from previously included articles (Table 1).

Stage 3: Study selection

The initial screening identified 2237 articles, from which we remove three duplicates. We excluded 2151 articles that did not meet the inclusion criteria. Finally, we assessed 74 full-text studies for eligibility, of which 63 were excluded. The search process yielded 23 papers which met inclusion criteria (See Fig. 1 for PRISMA-ScR diagram).

We then conducted a hand search of PubMed and Google Scholar for neuroscience articles including the keywords "chronic pain" and the ethics concepts included in Table 2. An additional 13 articles were identified that met our inclusion criteria, for a total of 36.

Table 1 Ethics concepts and examples of representative quotations extracted from the full-text

Ethics concepts	Authors	Journals	Representative Quotes
Quality of Life			
	Mcgirt MJ, Bydon M, Archer KR, et al	*J Neurosurg Spine*	"…the most conspicuous and potentially impactful care improvement opportunities in spine surgery involve optimizing outcomes of greatest importance to patients, specifically relief of pain and improvement of quality of life (QOL) as well as decrease of disability"
	Hunfeld JA, Perquin CW, Duivenvoorden HJ, et al	*J Pediatric Psychology*	"we defined quality of life as a multidimensional concept that encompasses broad domains of quality of life (e.g., physical, psychological and social functioning, and functional status) and the individual's overall satisfaction with life and health"
	Bandell-Hoekstra, I.E.N.G., Abu-Saad, H.H., Passchier, J et al	*Eur J Pain*	"The relationship between headache and QoL is complex. We assume a bi-directional relationship, in which headache influences QoL and QoL influences headache. Coping strategies act upon both"
	Linnemann A,. Kappert MB, Fischer S, et al	*Frontiers in human neuroscience*	"Fibromyalgia syndrome (FMS) is a medically unexplained condition mainly characterized by chronic widespread pain impacting heavily on patients' quality of life"
Autonomy			
	Nathaniel R. Greene, BA; C. Veronica Smith, PhD; Devin E. Jewell; Todd A. Smitherman, PhD	*Headache: The Journal of Head and Face Pain*	"Moving beyond traditional, purely hedonistic theories of psychological well-being, self-determination theory (SDT) proposes that the satisfaction of each of three basic needs – autonomy, competence, and relatedness – is fundamental to psychological growth and well-being" … "Continued research into the role of these basic psychological needs in headache may foster a better understanding of how headache affects quality of life and inform treatment approaches that focus on outcomes beyond mere symptom reduction."
	Tonya M. Palermo, PhD,* Janel Putnam, BA,* Geniel Armstrong, MA,w and Sarah Daily, BAz	*The Clinical journal of pain*	"Although autonomy has not, to our knowledge, been examined in adolescents with chronic pain, it is a potentially important developmental and family factor that may influence pain and disability."

Table 1 (continued)

Ethics concepts	Authors	Journals	Representative Quotes
Beneficence			
	de Tommaso, M., Navarro, J., Lanzillotti, C., Ricci, K., Buonocunto, F., Livrea, P., & Lancioni, G. E	*Frontiers in human neuroscience*	"This underlines the importance of considering the potential experience of pain also in patients in vegetative state and to appropriately assess a possible treatment also in those patients." "Pain and pleasure are inherently subjective experiences that persons can communicate to others verbally and non-verbally (Merskey et al., 1994). In non-communicative, severely brain-damaged patients, however, we can only infer those experiences by evaluating behavioral responses to external stimuli."
Transparency			
	Samuel et al	*Neuromodulation: Technology at the Neural Interface*	"Patients that view their PPNP as a failure of their original surgeon would not want them to reoperate to correct a residual anatomical abnormality or implant a SCS device, indicating a lack of transparency and communication as reasons for this preference"

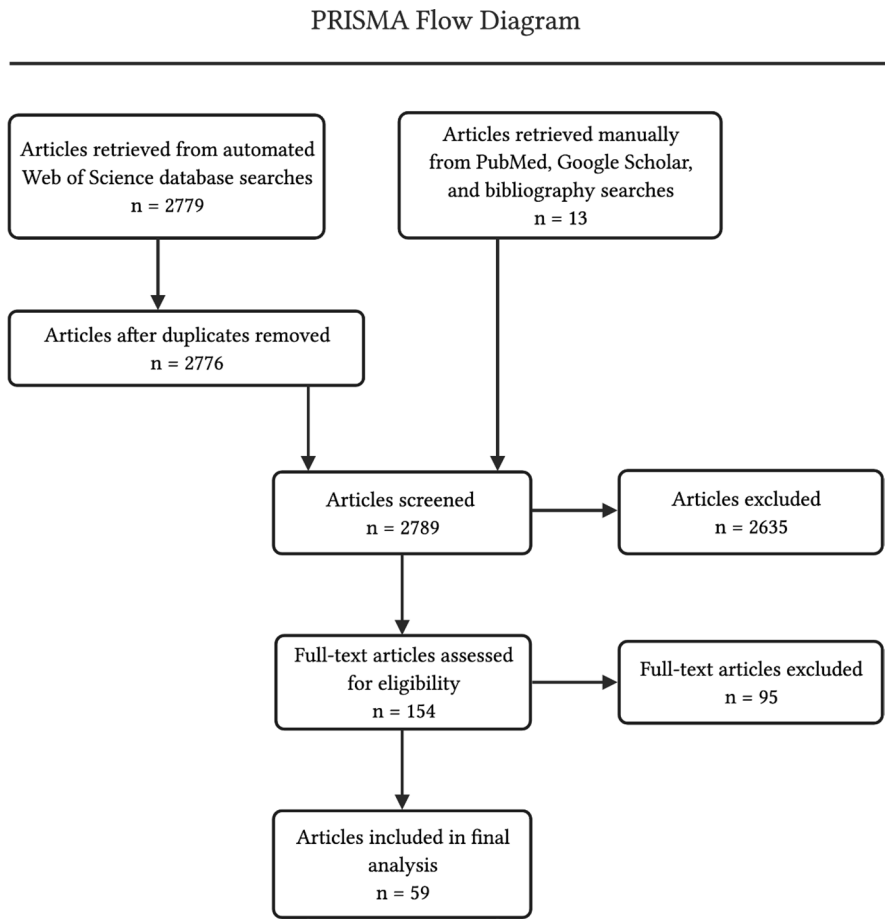

Fig. 1 PRISMA-ScR diagram illustrating the flow of information through the stages of this scoping review

We performed an updated search in April 2021 using the same methodology from the original search strategy. The search yielded 539 articles of which 484 were excluded. We reviewed fifty-five full text articles, and 23 articles were included in the final sample. Fifty-nine articles were included from both searches in our final sample.

Stage 4: Charting the data

The charting stage "involves extracting data from included studies" [37]. For our purposes, the relevant variables to extract from the selected studies were the 'ethics concepts' and their 'contextual representations' within the literature. We screened the full text of the 59 articles included in our final analysis, for the presence of ethics concepts and the nature of these. The ethics concepts described in Table 2 were selected for the following reasons. Beauchamp and Childress' four principles of biomedical ethics were included for their prominence in bioethics literature and likely familiarity with scientific researchers. A broader range of substantive and procedural ethics concepts such as trust/trustworthiness, accountability, transparency was included to potentially capture ethics concepts that have been raised in the pain ethics literature. Since we acknowledge that this is not an exhaustive list of ethics concepts, the authors involved in the analysis were encouraged to go beyond our preliminary list when charting the data to potentially identify concepts in our sample that were not included in our initial list. Table 3 provides an example of our charting process.

Stage 5: Collating, summarizing, and reporting the results

Levac et al. [37] identify three distinct phases of this step in the scoping review:

Table 2 Ethics concepts in our study and their operational definitions

Ethics concepts	Operational definitions
Accountability	Evidence that the authors discussed the shortcomings of their research, including the need to; integrate aspects other than purely the science of chronic pain into their research; discuss implications to patients lives with chronic pain; take this condition more seriously in the healthcare community than is currently the case
Autonomy	Self-legislation; the ability to make decisions in one's own self-interest consistent with one's values, beliefs, and priorities
Beneficence	The duty to promote the well-being of the patient
Justice	Concepts related to multiple forms of justice (e.g., social justice, distributive justice, restorative justice); articles may discuss the patients' symptoms being dismissed or disregarded by healthcare professionals or their condition not being given due consideration
Non-maleficence	The duty to not cause unnecessary harm; the article could include chronic pain in different settings (e.g. the pain due to a lack of treatment, or residual pain caused by a surgery or treatment)
Quality of Life	The state of an individual's life satisfaction, comfort, happiness, physical health, education, employment or family responsibilities, environment, mental health, and standard of living. One's perception of their wellbeing in relation to their value system, culture, and goals
Respect	The treatment of patients with dignity and regard of personhood; e.g. not viewing chronic pain patients as being drug-seekers
Transparency	Disclosure between the patient and healthcare professional; all aspects of the assessment, diagnostic, and pain management process being accessible to the patient; open line of communication; researchers being open about their methods and research gap; the need of transparency in chronic pain research, etc
Trust and trustworthiness	Trust between the healthcare professional and patient; trust that the patient would be provided non-judgmental and non-discriminatory care; trust in the appropriate management of chronic pain

1. "Analysis (including descriptive numerical summary analysis and qualitative thematic analysis)
2. Reporting the results and producing the outcome that refers to the overall research purpose
3. Consider the meaning of the findings as they relate to the overall study purpose; discuss implications for future research, practice and policy"

Each of these distinct steps were completed in the course of this review. Please see Tables 1 and 3, Figs. 2 and 3, and the Findings below.

Findings

Quality of life (QoL) was the most prevalent concept in the included articles, appearing in 78% (n = 46) of our sample. Additional ethics concepts identified included: Autonomy (n = 5), Transparency (n = 4), and Beneficence and Nonmaleficence (n = 4). One article may have had more than one ethics theme. Table 1 describes the ethics concepts that appeared in the reviewed articles, contextualized with sample quotations. Please see Figs. 2 and 3 for occurrence of publications by journal and by year, respectively.

Quality of Life (n = 46)

QoL appeared as a concept in our review ranging from completely undefined to clearly defined. In Linnemann et al. [38], for example, QoL is vaguely referenced as being impacted by fibromyalgia: "Fibromyalgia syndrome (FMS) is a medically unexplained condition mainly characterized by chronic widespread pain impacting heavily on patients' quality of life". However, in Hunfield et al. [39], QoL is more thoroughly defined as "a multidimensional concept that encompasses broad domains of quality of life (e.g., physical, psychological and social functioning, and functional status) and the individual's overall satisfaction with life and health". This inconsistency appeared throughout our review, highlighting a potential disparity in how rigorously QoL is conceptualized in the context of chronic pain neuroscience.

In another paper which assessed the impact of chronic headaches on QoL, Guitera et al. [40] suggested that "there is no consensus definition" of QoL and emphasized the subjective nature of QoL assessments: "health-related QoL represents the net effect of an illness and its therapy on a patient's perception of his or her ability to have a useful and fulfilling

Table 3 Charting Process Summary

References	Journals	Ethics Concepts	Representative Quotes	Comments
Guitera, V., Muñoz, P., Castillo, J., & Pascual, J. (2002). Quality of life in chronic daily headache: a study in a general population. Neurology, 58(7), 1062–1065	Neurology	Quality of life	"There is no consensus definition, but health-related QoL represents the net effect of an illness and its therapy on a patient's perception of his or her ability to have a useful and fulfilling life" // "Quantification of the impact of QoL in headaches is important for several reasons: First, the information can be used to assess aspects of the burden of the disease on individuals with headache. Second, it can be used as an outcome measure in clinical trials or clinical practice. Third, it can be used to identify treatments that optimize outcomes. Finally, and only for generic instruments, it can be used to compare the specific burdens of various disease categories" // "The most widely used generic instrument is the Short Form-36 (SF-36), a questionnaire developed by the Rand Corporation to assess QoL in the Medical Outcomes Study. It has been carefully tested, vali- dated, and used in patients with chronic diseases including chronic headaches. Most authors have used the International Headache Society (IHS) classification to study QoL of patients with primary headache disorders and considering episodic but re- current headaches as synonymous of chronic head- aches." // "Our results demonstrate that in the general population, CDH itself induces a reduction in all QoL aspects studied with the SF-36. CDH decreases the QoL in a rather specific way. Vitality, bodily pain, role physical, and social functioning were the most affected aspects, whereas general health and role physical were closer to control values."	QoL substantively defined and discussed

Table 3 (continued)

References	Journals	Ethics Concepts	Representative Quotes	Comments
Carreon, L. Y., Glassman, S. D., Djurasovic, M., Dimar, J. R., Johnson, J. R., Puno, R. M., & Campbell, M. J. (2009). Are preoperative health-related quality of life scores predictive of clinical outcomes after lumbar fusion?. Spine, 34(7), 725–730	Spine	Quality of life	"This is supported by the results of this current study. Similar to recent studies demonstrating that older patients undergoing lumbar fusion had similar improvements in HRQOL compared with younger patients,25 the current study did not find age to be a significant factor affecting outcome after lumbar fusion surgery." // "This study evaluated the effect of preoperative MCS, preoperative PCS, preoperative ODI, back pain predominance, BMI, age, smoking status, and workers' compensation on change in HRQOL after lumbar fusion."	QoL not substantively defined despite being used as a study metric

Table 3 (continued)

References	Journals	Ethics Concepts	Representative Quotes	Comments
Hunfeld JA, Perquin CW, Duivenvoorden HJ, et al. Chronic pain and its impact on quality of life in adolescents and their families. J Pediatr Psychol. 2001;26:145–153	J Pediatr	Quality of life	"Studies on chronic pain and its relationship to quality of life in adolescents show positive relation- ships between pain and psychological distress, somatic complaints (Andrasik et al., 1988; Balague et al., 1995; Brattberg, 1994; Cunningham et al., 1987; Larsson, 1988), or disability (Holden, Gladstein, Trulsen, & Wall, 1994). In these studies the most investigated chronic pain types were headache (mi- graine, tension-type headache) and back pain." // "Many studies on the impact of chronic pain have assessed separate quality of life domains, such as disability (Taimela et al., 1997), depression, or anxiety (Andrasik et al., 1988) rather than using comprehensive quality of life measures." // "In line with Langeveld et al. (1997), we defined quality of life as a multidimensional concept that encompasses broad domains of quality of life (e.g., physical, psychological and social functioning, and functional status) and the individual's overall satisfaction with life and health (Spilker, 1996)." // "In short, there is a paucity of research into pain parameters in a prospective (i.e., diary) design in a community sample of youngsters, with evaluation of the consequences for quality of life of the youngsters and the impact on the family Therefore, the purpose of this study was to gain knowledge on the intensity and frequency of chronic pain in adolescents, their quality of life, and the impact of chronic pain on the family, with a diary and questionnaires. We asked the following questions. What is the course of the pain during the day? What is the relationship with gender? We tested the hypothesis that the greater the pain, the poorer the quality of life of the youngsters and the greater the negative impact on the family."	QoL well defined, substantively addressed, and used as a research metric

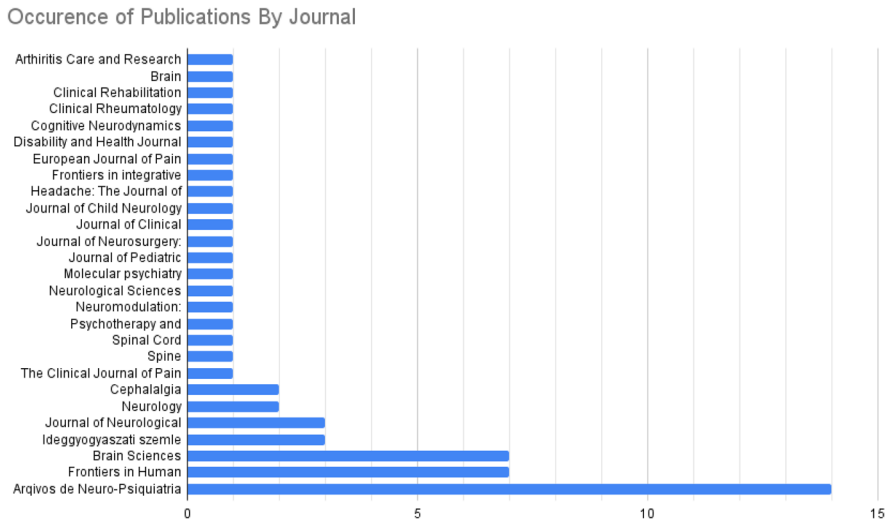

Fig. 2 Occurrence of Publications by Journal

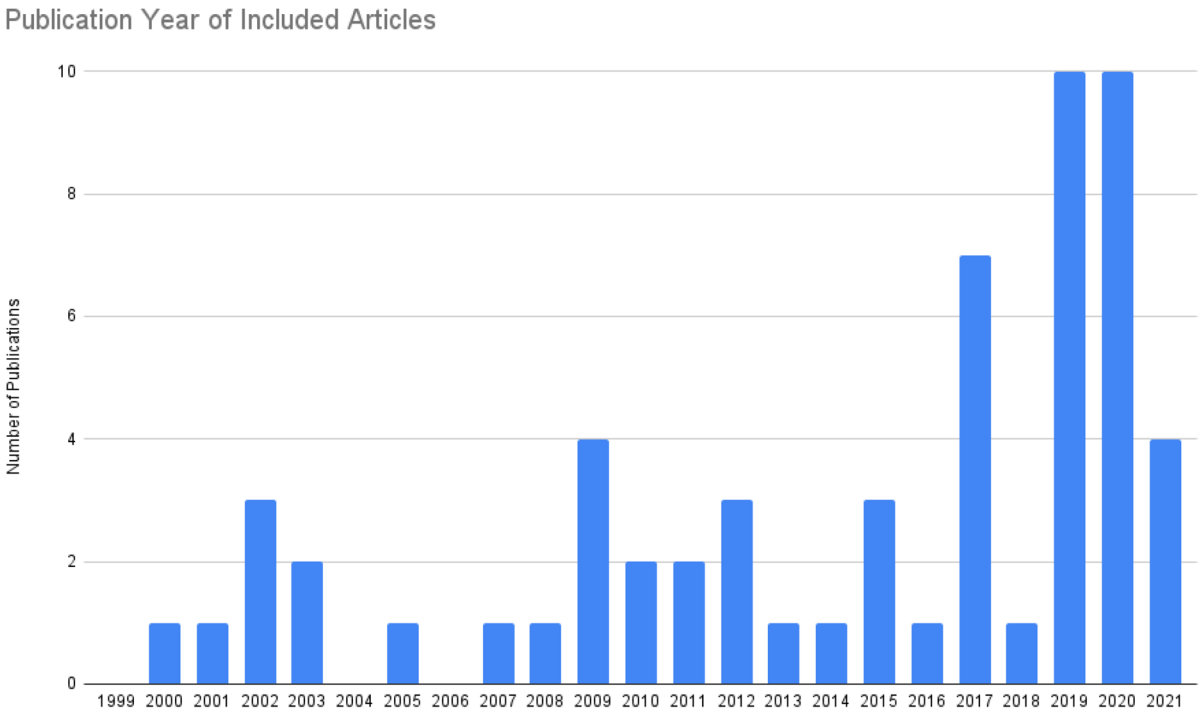

Fig. 3 Publication year of included articles

life". Nonetheless, the authors stressed that standardized quantifications of QoL have several important clinical and scientific applications, for example, as a measurement of clinical trial outcomes, and for comparisons between the burdens of different diseases [40]. Other authors also stressed the individual, subjective nature of QoL as "an individual's assessment of their general well-being and position in life as perceived within the context of their culture, value systems, goals, and concerns" [41].

Other papers discussed QoL in relation to disability, either by correlating the two, visualizing disability as a domain of QoL [39], or by asserting that disability reflected a lower QoL or vice versa. For

example, in Brna et al., "the concept of health-related quality of life is intertwined with disability, reflecting the impact of illness on the patient's perception of his or her ability to live a fulfilling life" [42], while McGirt et al. reported that the most relevant outcome in spinal surgery is an "improvement of quality of life (QOL) as well as decrease of disability" [43].

Autonomy (n=5)

The included articles discuss autonomy in a variety of ways, although most situate autonomy in a framework that addresses the bidirectional relationship between patients' autonomy and the severity of their chronic pain. For example, Castro and Daltro highlight autonomy by relating the power of a patient's decision making in relation to the degree of their chronic pain, suggesting that lower perceived autonomy contributes to increased pain [44].

Similarly, Lewandowski & Palermo suggest that lower levels of autonomy in pediatric populations with persistent pain are correlated to higher functional disability [41]. Both these papers explicitly demonstrate the degree of chronic pain and negative consequences of actual or perceived lack of autonomy. Lewandowski and Palermo describe autonomy differently than Castro and Daltro, as the latter discusses how loss of autonomy correlates to poorer health outcomes, whereas the former simply states that it does [44, 45].

Some authors, including Hill et al., discuss the autonomy and related concepts without explicitly naming it [46]. They encourage individuals living with chronic spinal cord pain to, for example, "focus on their capability and competence rather than their inadequacies or limitations."

Transparency(n=4)

Among the articles included in our study, transparency aims to make clear the processes and practices occurring between patient and clinician, including aspects of the assessment, diagnostic, and treatment processes. Samuel et al. gauged patient perspectives on persistent postoperative neuropathic pain and reported that lack of transparency between patients and physicians can contribute to poorer health outcomes. For example, patients would not want their original surgeon to re-operate in the event of an adverse outcome with the surgery, reported that the surgeon's lack of transparency and communication about possible outcomes [47]. Some participants stated that they would rather live with their pain than trust that the surgeon will help alleviate their pain in the future [47]. Ferrari and Russell use transparency to suggest that the lack of available research in fibromyalgia contributes to misunderstood perspectives of both physicians and patients, ultimately leading to poorer health outcomes: "Our clinical experience has informed us that fibromyalgia patients often report their condition as "unfair" …in our experience and that of others, many rheumatologists refuse to accept patients with this diagnosis" [48].

Beneficence and Non-maleficence (n=4)

While distinct concepts, beneficence and non-maleficence represent two sides of the same coin. Beneficence is the obligation to promote the good of the patient and non-maleficence is the obligation to prevent, remove, and refrain from inflicting harm [49]. When a person suffers from chronic pain, a healthcare professional has an ethical obligation to promote the alleviation of pain and suffering and prevent the worsening of pain.

In Onur et al. [50] for example, the authors articulate that "the impacts of positive strategies on quality of life are different from those of negative strategies". The authors stress that "the use of isolation to prevent the emergence of migraine attacks seems to work initially, but it can be harmful in the long term." This bifurcated positive and negative approach to chronic pain treatment mirrors the concept of beneficence and non-maleficence.

Discussion

This hybrid bibliometric and scoping review explored the extent to which authors of empirical chronic pain neuroscience articles engage with ethical issues in their peer reviewed publications. We identified a lack of breadth and depth in the discussion of ethical concepts in this literature. While somewhat expected, the limited ethics content in our findings can have implications for people who live with chronic pain as the research is mobilized for clinical use.

The Focus on Quality of Life

Our review identified a disproportionate emphasis on QoL. QoL is a comprehensive, subjective measure of an individual's wellbeing which typically accounts for the physical, psychological, social, economic, and even existential dimensions of a person's life. The use of the broad term QoL in the literature may both legitimize and delegitimize the subjectively defined QoL of individuals living with persistent pain. On the one hand, validated QoL assessment tools can legitimize subject self-reports. On the other hand, the use of so-called objective metrics may fail to capture the phenomenology of living with persistent pain, may intensify pain stigma, and contribute to an unfair downgrading of credibility about their experiences [18]. Taken together, this makes QoL a relevant concept from an ethics perspective.

There is no consensus in the philosophical, bioethics, or health science literature regarding the definition of QoL as it relates to chronic pain [40, 51]. This is likely for two reasons. First, QoL is a broad and complex concept and second, QoL is individually defined. Despite a lack of consensus, it is undisputed that an individual's QoL can be affected by the experience of persistent pain. For this reason, we find it appropriate to problematize the use of QoL as a study metric if it is unqualified or left undefined.

Most articles in our review did not consider the ethical complexity of the QoL concept. This is likely due in part to the chasm between one's phenomenological experiences of pain and the ability of objective measures to capture those experiences. Disability scholars and historians have long argued that there is a history of QoL being construed in a presumed objective manner that can lead to the oppressive imposition of a middle class, white, able-bodied, and distinctly American quality of life. The subjective nature of QoL has been argued for repeatedly, situated within the philosophy of mind (see: the epistemological problem of other minds) and critical disability studies but has particular significance in the chronic pain literature because the experience of pain, and its associated suffering, is subjective. It is important that the possibility of the objective study of chronic pain does not marginalize the perspectives and experiences of those whose chronic pain may not be represented meaningfully by visualizing technologies such as fMRI—and who may be harmed both epistemically, ethically, and clinically as a result [18].

Autonomy, Transparency, and Beneficence and Non-maleficence

Our reviewed identified far fewer articles that discussed autonomy, transparency, and beneficence and non-maleficence explicitly, despite these being common bioethics principles. In our findings, Autonomy and Beneficence and Non-maleficence were used in ways that are somewhat tangential to their original conceptions. For example, we did not find instances where autonomy was used to mean *self-legislation* but rather used synonymously for independence or personal choice, or as a substitute for related ethico-legal terms such as competence. Indeed, the notion of (moral) autonomy in bioethics, science, and healthcare has strayed from its Kantian origins and is sometimes confused with John Stuart Mill's notion of liberty [52]. Similarly, articles invoking Beneficence and Non-maleficence did not appeal to the duty to promote the patient's welfare or the duty to not cause harm but rather discussed treatments that might achieve some good but have harmful long-term consequences. The relative lack of attention to these principles in the literature is surprising given their association with utilitarianism, which is entirely predicated on the maximization of pleasure and the minimization of pain. Likewise, minimal attention to transparency was notable especially since greater transparency in decisions-making between clinician and person with chronic pain, for instance, can help support informed decision-making and trustworthiness in pain management. In a research context, transparency can refer to researchers being open about their methods and the need for this in pain research [53]. Increased transparency allows for research to be reproducible and can help prevent the file drawer effect [54].

Opportunities for Further Ethical Reflection in Chronic Pain Neuroscience

There were aspects of the articles in our sample that are highly relevant to issues in the neuroethics literature but were either absent from the manuscript or were inadequately addressed. The lack of discussion of core ethics themes has been identified previously in a review of fMRI studies of mental health

disorders [31]. We believe this evidence of absence provides an opportunity for future researchers to provide more thoughtful, deeper integration of neuroethics into chronic pain neuroscience research designs and potential clinical translations. We describe two potential areas.

Firstly, justice concepts did not feature prominently in our findings, but we did identify one article that described perceived injustice in the context of chronic pain research. Ferrari & Russell report that fibromyalgia patients experience a stronger sense of perceived injustice than patients with rheumatoid arthritis [48]. Perceived injustice is defined by the authors as "a multidimensional construct, composed of elements that assess the severity of loss, irreparability of loss, blame and sense of unfairness". Perceived injustice as core to the lived experience of chronic pain has been a focus of scholarship in pain psychology [55]. People living with conditions such as fibromyalgia and chronic regional pain syndrome may experience a greater sense of injustice as their conditions have, historically, received far less media attention and research funding. People living with chronic pain are also more likely to report discrimination than those without chronic pain [56]. The absence of explicit considerations of fairness, distributive justice, and equity in our review suggests a potential lack of engagement with pressing ethical issues within the empirical neuroscience literature. Given the deep history of cultural, gender-based, and racial inequities in pain assessment and treatment [20, 57, 58] and inequalities related to structurally disadvantaged populations, greater attention should be paid to concepts of justice and fairness within chronic pain neuroscience.

Secondly, many neuroethics scholars' endeavor to anticipate and address the ethical issues related to experimental neurotechnologies such as fMRI, DBS, repetitive transcranial magnetic stimulation, and brain-computer interfaces, including how some of these technologies are being combined with forms of artificial intelligence. Neuroethics scholars have identified topics for ethical consideration in this area such as privacy, identity, free will, and the fair distribution of benefits and risks among society [17]. However, like the findings of our review, neuroethics scholarship tends to emphasize how these ethical issues are relevant to *individuals* and understates the importance of the impact on *populations* [59]. This includes how social goods such as privacy and trust are unequally distributed in societies, as well as how a lack of racial, class, and gender diversity in research study samples [60] has implications for how the findings of research are applied to people living with pain. For example, it is well established that massive racial and class inequities related to pain exist. While not an article included in our sample, Pierson et al. used a deep learning approach to predict patients' experiences of knee osteoarthritis pain by training the algorithm on knee X-rays [61]. The authors found unexplained racial inequities in pain as well as for lower-income and less-educated patients. Yet, when they applied an algorithmic measure of severity, the unexplained inequities were decreased. The authors concluded that the inequities were based in the lack of racial and socioeconomic diversity of the data set. Given that pain severity measures can influence treatment decisions, correcting for these inequities in severity has important implications for practice if technologies such as fMRI or artificial intelligence are ultimately integrated into pain management contexts. Importantly for neuroethical reflection, the potential benefits of neuroscience and neurotechnology research on chronic pain will likely be enjoyed by populations who have the power and resources to access them [58, 59].

Limitations

We found a limited engagement with ethics concepts in the empirical chronic pain neuroscience literature, as some researchers may assume that receiving institutional ethics approval is akin to engaging in the ethical dimensions of their research [30]. Some ethics concepts may have been discussed and integrated into the articles present in the first stage of our search but then excluded because the ethics keyword did not appear directly in the text. We limited our search to the top, middle, and bottom 20 neuroscience journals ranked by impact factor; future research may consider including a wider scope. Because we conducted a hybrid bibliometric-scoping review rather than a systematic review, we did not assess the quality of the included studies. As our search was restricted to the empirical literature, we did not include literature such as opinion pieces or editorials that may have discussed ethical issues directly. Many contemporary prominent science and medical journal have dedicated spaces to viewpoints and perspective articles where ethics issues

may be addressed, and thus were overlooked in our search strategy. Although we used multiple search methods to identify relevant articles, some relevant studies may have been missed. What is more, we did not conduct a systematic review and did not aim to identify every relevant study as an exhaustive list of the literature is not feasible. Instead, our goal was to find a reasonably representative sample of the empirical chronic pain neuroscience literature.

Conclusions

This hybrid bibliometric scoping review explored the presence of ethics concepts in the empirical chronic pain neuroscience literature. We underscored the need for neuroscience researchers in chronic pain to deliberately reflect upon the ethical implications of their work and to integrate this into their scholarship. Scientific advancement devoid of conscientious ethical consideration has resulted in moral transgressions in the past and still occurs in present day. Issues related to pain and related technologies have played a primary role in this history [62–64].

We hope to see a stronger integration of neuroethics into chronic pain neuroscience. We also hope our findings will be a catalyst for more substantive ethical analyses within the empirical chronic pain literature. As chronic pain neuroscience research is being developed, integrating ethics in all stages of the research process can encourage research teams be creative in their designs, anticipate challenges that might arise, and decide on the most responsible way to proceed. Collaborations between neuroethicists and neuroscientists can promote the ethical integration of emerging methods of chronic pain assessment, diagnosis, and treatment technologies, and support the translation of the research findings into clinical practice. We encourage the exploration and utilization of a greater diversity of relevant ethics concepts specifically as study metrics in future empirical neuroscience research. We hope that stronger and more frequent collaborations between people living with chronic pain from a range of class, gender, and racialized backgrounds, together with neuroscientists and ethicists, will yield not only more ethical persistent pain care but also better experiences and outcomes for people living with chronic pain.

Acknowledgements The authors are grateful for Dr Karen Davis for helpful discussions relating to the topic area, as well as the feedback from Sandra Woods on an earlier version of this manuscript. The group discussions at the CIHR-funded workshop entitled The Ethics of Pain Research, Management, and Policy: A Planning and Knowledge Exchange Meeting (Toronto, 2018) provided the inspiration for this manuscript.

Declarations

Funding and/or Conflicts of interests/Competing Interests This paper was supported by a grant from the Canadian Institutes of Health Research CIHR-PCS 161829. The authors report no conflicts of interest.

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