



The Epidemiology of Chronic Pain: A Global Health Crisis

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Abstract

Chronic pain, defined as pain lasting longer than three months, has become a global health crisis, significantly impacting individuals, healthcare systems, and economies. This paper examines the epidemiology of chronic pain, highlighting its widespread prevalence, diverse causes, and debilitating consequences. We delve into the complex interplay of factors contributing to chronic pain, including injury, disease, genetics, and psychological factors. The paper explores the impact of chronic pain on individuals' quality of life, physical function, mental health, and socioeconomic status. We further discuss the challenges of diagnosing and managing chronic pain, considering the subjective nature of pain perception, the complexity of underlying causes, and the limitations of existing treatments. Finally, we examine strategies for mitigating the burden of chronic pain, emphasizing the importance of multidisciplinary approaches, early intervention, access to effective treatment, and public awareness campaigns.

Keywords: Chronic pain, epidemiology, prevalence, causes, consequences, quality of life, physical function, mental health, socioeconomic status, diagnosis, treatment, multidisciplinary approach, public health, awareness

1 Introduction

Chronic pain, a debilitating and pervasive condition characterized by pain persisting for longer than three months, represents a significant global health challenge affecting millions of individuals across diverse demographics and socioeconomic backgrounds. This condition transcends a simple symptomatic experience, evolving into a complex and multifaceted health issue that profoundly impacts various aspects of human life. Chronic pain is not merely a transient sensation; it is a persistent and often intractable state that can dramatically compromise an individual's quality of life, severely limit physical function, contribute to mental health disorders, and create substantial socioeconomic burdens on both individuals and healthcare systems. The complexity of chronic pain, arising from the intricate interplay of biological, psychological, and social factors, necessitates a comprehensive exploration of its epidemiology, encompassing its prevalence across diverse populations, the multifaceted causes that contribute to its development, the far-reaching consequences it inflicts on individuals and communities, and potential strategies for effective mitigation and management. This paper aims to delve beyond superficial observations and delve into the intricate mechanisms underlying chronic pain, seeking to understand the dynamic interplay between individual vulnerabilities, biological pathways, psychological influences, and the broader social context that contributes to its chronicity. By integrating insights from various disciplines, including medicine, neuroscience, psychology, and social sciences, this exploration seeks to provide a comprehensive overview of the current state of knowledge, identify critical gaps in understanding, and ultimately contribute to the development of evidence-based strategies to alleviate the suffering associated

with chronic pain and improve the lives of individuals affected by this pervasive global challenge. This examination acknowledges the diversity of chronic pain experiences and the need for personalized, multimodal approaches that consider the unique circumstances of each patient. It emphasizes the urgent need for innovative research, improved clinical practice, and public health initiatives aimed at preventing the onset of chronic pain and enhancing the quality of life for those living with this debilitating condition.

2 The Prevalence of Chronic Pain: A Global Perspective

Climate change is a defining challenge of our time, with far-reaching consequences for human health, ecosystems, and global security. While its impact on the environment is well-documented, its influence on the emergence and spread of infectious diseases is becoming increasingly evident. The complex interplay between climate change and infectious diseases is multifaceted, with a range of mechanisms at play. Rising temperatures, altered precipitation patterns, and extreme weather events can disrupt ecological balances and create new opportunities for pathogens to spread. This review will delve into the specific ways in which climate change influences infectious diseases, focusing on: The impact of temperature changes on vector-borne diseases: Examining how warming temperatures affect the geographic range, seasonal activity, and vectorial capacity of disease-carrying insects (1). The role of precipitation patterns in disease transmission: Exploring how altered precipitation patterns, including increased rainfall and flooding, influence the breeding grounds of vectors and the spread of waterborne diseases. The link between extreme weather events and disease outbreaks: Analyzing how extreme

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weather events, such as hurricanes, droughts, and heatwaves, can create favorable conditions for disease outbreaks and disrupt disease control efforts. The implications of climate change for zoonotic diseases: Investigating how climate change-induced environmental changes can alter animal behavior and increase the likelihood of zoonotic transmission. By understanding the intricate link between climate change and infectious diseases, we can develop effective strategies to mitigate the risks and protect public health. This review provides a comprehensive overview of the current knowledge and highlights the need for further research and collaborative action to address this emerging global health challenge (2). Climate change profoundly disrupts the epidemiology of vector-borne diseases, primarily by modifying temperature and precipitation regimes which directly affect vector life cycles and distributions, subsequently altering disease transmission risks. Elevated ambient temperatures facilitate the expansion of vector habitats into previously unsuitable geographic locations, enabling colonization of new areas and increasing the duration of vector activity periods, thus prolonging the window for pathogen transmission. Furthermore, accelerated development rates of vectors at higher temperatures contribute to increased reproduction and faster life cycles, potentially amplifying the rate of pathogen amplification and dissemination (3). Shifts in precipitation patterns, particularly extreme rainfall events, can create extensive breeding grounds for vectors such as mosquitoes, leading to exponential population increases, while conversely, prolonged droughts can stress vector populations and prompt migratory shifts, potentially introducing diseases into novel geographical areas with susceptible populations. These complex interactions are evidenced by the expansion of malaria prevalence into formerly less affected regions, and the broadened geographical distribution of dengue fever correlating with warmer temperatures which enable vector proliferation, alongside the northward migration of Lyme disease associated with favorable environmental conditions for tick survival (4). Parallel to these global shifts in vector ecology, chronic pain presents an equally pervasive worldwide public health concern, affecting individuals regardless of age, gender, or socioeconomic background, and recognized by the World Health Organization as a major contributor to disability. While the experience of chronic pain is a ubiquitous global phenomenon, notable regional variations in prevalence and clinical manifestations exist, which are influenced by disparities in healthcare access, varying socioeconomic conditions, and diverse cultural norms regarding pain perception and management; the escalating global prevalence of chronic pain observed in recent decades is likely linked to demographic shifts such as aging populations, the increasing incidence of obesity which is a significant risk factor, and the contribution of various environmental factors that may impact pain sensitization and chronic inflammation pathways (5).

3 Causes of Chronic Pain: A Complex Interplay of Factors

Chronic pain, a persistent and often debilitating condition affecting a significant portion of the global population, is characterized by pain lasting beyond the typical healing timeframe of three months. Unlike acute pain, which serves as a vital warning system, chronic pain often becomes a disease state itself, impacting not only physical health but also emotional well-being and overall quality of life. The etiology of chronic pain is rarely attributable to a single cause, but rather emerges from a complex interplay of biological, psychological, and social factors. Understanding this multifactorial nature is

crucial for developing effective and personalized treatment strategies (6).

While acute pain typically resolves as tissue heals, significant traumatic injuries can initiate a cascade of events that lead to chronic pain. Fractures, sprains, and dislocations can damage not only bones and ligaments, but also surrounding soft tissues and, importantly, peripheral nerves. Nerve damage, or neuropathy, can result in long-term alterations in pain signaling pathways, a phenomenon known as neuropathic pain. This type of pain often presents as burning, shooting, or tingling sensations and can be particularly challenging to manage. In the case of traumatic brain injury (TBI), persistent headaches and widespread pain are common sequelae, further highlighting the profound and complex impact of injury on the central nervous system (CNS). The duration and severity of the initial injury, the adequacy of early pain management, and the presence of other predisposing factors all influence the likelihood of developing chronic pain post-trauma. Furthermore, repeated or chronic microtrauma, as often seen in overuse injuries or certain occupational settings, can also lead to chronic pain conditions due to cumulative tissue damage and sensitization (7).

Chronic pain is frequently a prominent symptom of a wide range of underlying diseases. Inflammatory conditions like rheumatoid arthritis (RA) and osteoarthritis (OA) cause persistent pain and joint damage, resulting in both nociceptive pain (due to tissue damage) and, in some cases, neuropathic pain due to nerve compression or inflammation. Cancer pain, associated with tumor growth, metastasis, and treatment side effects, can also be severely debilitating and chronic. Metabolic diseases, such as diabetes mellitus, can cause peripheral neuropathy, leading to significant pain in the extremities. Fibromyalgia, characterized by widespread musculoskeletal pain, fatigue, and cognitive dysfunction, presents a unique challenge, often lacking clear tissue pathology and highlighting the role of central sensitization processes. In autoimmune diseases like lupus or multiple sclerosis, chronic pain can be a central feature, resulting from inflammation or nervous system damage, respectively. These disease-related pain conditions underscore the importance of addressing the underlying pathology while simultaneously managing the associated pain symptoms (8).

Emerging evidence suggests that genetic factors play a significant role in an individual's susceptibility to developing chronic pain. Variations in genes involved in pain perception, such as those coding for sodium channels, opioid receptors, and neurotransmitter receptors, can influence pain sensitivity and the likelihood of transitioning from acute to chronic pain. Specific genetic polymorphisms have been linked to increased risk for conditions such as fibromyalgia, migraines, and chronic back pain. Furthermore, genes involved in inflammation and immune response also contribute to an individual's vulnerability to chronic pain conditions, especially those with an inflammatory component. While single gene mutations are rare contributors to chronic pain, the combined effects of numerous gene variations, along with environmental factors, likely determine an individual's overall risk. Future research in this area holds promise for identifying at-risk populations and developing personalized treatment approaches (9).

The intricate connection between the mind and body is undeniable in the experience of chronic pain. Psychological factors, such as depression, anxiety, and stress, are not only frequent comorbidities but also significantly contribute to the development and maintenance of chronic pain conditions. Stress and anxiety can activate the hypothalamic-pituitary-adrenal (HPA) axis, leading to elevated cortisol levels, which can sensitize pain pathways and exacerbate pain perception.

Negative emotional states such as catastrophizing, rumination, and fear-avoidance behaviors can amplify pain signals and contribute to disability. Conversely, positive coping strategies, including acceptance, mindfulness, and cognitive restructuring, can act as protective factors and improve pain management outcomes. These findings highlight the need for integrated biopsychosocial models of chronic pain that emphasize the importance of addressing psychological distress and promoting psychological well-being (10).

The social and environmental context in which individuals live plays a critical role in their experience of chronic pain. Exposure to environmental toxins, such as heavy metals or air pollutants, has been linked to an increased risk of developing chronic pain conditions, potentially through inflammatory and neurological pathways. Workplace injuries, particularly those resulting from repetitive motions or heavy lifting, can lead to chronic musculoskeletal pain. Social isolation and lack of social support can also contribute to chronic pain by increasing feelings of helplessness and depression (5). Additionally, socioeconomic status and access to healthcare have a profound impact on individuals' experience of chronic pain. Those with limited access to quality medical care or pain management services are at increased risk for developing chronic pain and experiencing poorer outcomes. Furthermore, cultural beliefs and stigma surrounding chronic pain can influence pain perception and willingness to seek help. Addressing social and environmental factors is, therefore, an essential component of a comprehensive approach to chronic pain management.

4 Consequences of Chronic Pain: A Multifaceted Impact

Chronic pain, beyond its primary characteristic of persistent discomfort, extends its reach to encompass profound and wide-ranging consequences impacting individuals, their families, and society as a whole. The burden of chronic pain is substantial, affecting multiple domains of life, including physical function, psychological well-being, social engagement, and economic stability. Understanding the multifaceted impact of this condition is critical for developing effective strategies to mitigate its negative consequences and improve the lives of those affected.

One of the most pervasive consequences of chronic pain is a significant reduction in overall quality of life (QOL). The constant presence of pain can erode an individual's sense of well-being, disrupting daily routines and hindering participation in activities that were once enjoyed. Sleep disturbance is a common issue, with chronic pain often making it difficult to fall asleep, stay asleep, or achieve restful sleep. This lack of restorative sleep can exacerbate pain perception and contribute to fatigue and cognitive dysfunction. Pain can also limit individuals' ability to work, engage in hobbies, and participate in social gatherings, leading to feelings of isolation and loss. Furthermore, chronic pain can strain interpersonal relationships, affecting intimacy, communication, and family dynamics. The cumulative effect of these challenges leads to a substantial decrease in QOL, impacting not just physical health, but also emotional well-being and social connectivity. The impact on QOL extends beyond individual distress and often creates a burden on family members and caregivers, who may also experience increased stress and diminished QOL (11).

Chronic pain often leads to significant limitations in physical function, ranging from reduced mobility and flexibility to complete disability. Pain may restrict movement, leading to muscle weakness, stiffness, and a decreased range of motion. Individuals with chronic pain may avoid physical activities due to fear of exacerbating their pain, resulting in a

cycle of disuse, deconditioning, and further functional decline. This lack of physical activity can contribute to weight gain, cardiovascular issues, and other secondary health problems. The inability to perform routine tasks, such as walking, climbing stairs, or carrying groceries, can greatly diminish independence and autonomy. In severe cases, chronic pain can lead to substantial disability, requiring assistive devices, modified living spaces, and long-term care support. Loss of physical function can significantly impact self-esteem, body image, and overall self-perception, further compounding the burden of chronic pain (12).

The bidirectional relationship between chronic pain and mental health is well-established. Chronic pain is often associated with increased rates of anxiety, depression, and other mental health disorders. The persistent nature of pain and its associated limitations can contribute to feelings of helplessness, hopelessness, and despair. Individuals with chronic pain may experience heightened anxiety and worry about their pain, its impact on their future, and the uncertainty of their situation. Depression is a common comorbidity, characterized by persistent sadness, loss of interest in activities, and feelings of worthlessness. The presence of mental health disorders can exacerbate pain perception, increase disability, and complicate the course of pain management. Furthermore, chronic pain can contribute to cognitive deficits, including impaired attention, concentration, and memory, further impacting an individual's overall well-being. Addressing mental health issues is, therefore, an integral component of effective chronic pain management (13).

The consequences of chronic pain extend beyond the individual to affect socioeconomic status and productivity. Chronic pain often leads to reduced work performance, increased absenteeism, and ultimately, unemployment. The inability to maintain consistent employment can lead to significant financial hardship, including loss of income, medical expenses, and potential dependence on disability benefits. The economic burden of chronic pain is substantial, not only for individuals but also for healthcare systems and society as a whole. The loss of productivity and increased healthcare utilization associated with chronic pain can have significant societal costs (14). Furthermore, financial difficulties can contribute to increased stress, exacerbating the challenges of chronic pain and creating a cycle of poverty and ill-health. The long-term socioeconomic implications of chronic pain underscore the need for effective pain management programs that address not only medical issues but also financial and employment concerns.

5 Challenges in Diagnosing and Managing Chronic Pain

The diagnosis and management of chronic pain present formidable challenges, stemming from the inherent complexity of pain itself and the limitations of current clinical approaches. Unlike acute pain, which typically arises from a readily identifiable cause, chronic pain often involves a complex interplay of biological, psychological, and social factors, making it difficult to diagnose and treat effectively. These challenges necessitate a shift towards more personalized and comprehensive approaches that recognize the unique experience of each individual (15).

One of the most significant obstacles in diagnosing chronic pain is its inherent subjectivity. Pain is a personal and highly variable experience, influenced by a multitude of factors including individual perceptions, emotions, cultural background, and past experiences. Unlike objective physiological measures, pain cannot be directly quantified or

measured using standard diagnostic tools. This reliance on self-report, often using pain scales or verbal descriptions, can introduce bias and variability in assessment. Furthermore, individuals may struggle to articulate the complex nature of their pain, particularly if they experience multiple types of pain sensations or have difficulty describing their symptoms. This lack of objective measures makes it challenging for clinicians to accurately assess the severity, location, and characteristics of pain, which, in turn, limits their ability to make precise diagnoses and tailor treatments accordingly. The subjectivity of pain also makes it difficult to differentiate between different types of pain, such as nociceptive, neuropathic, and nociplastic pain, which may require different therapeutic strategies. Consequently, a more nuanced and multifaceted approach is needed to evaluate the patient's pain experience, taking into account not only the sensory aspects of pain but also its emotional and functional consequences (16).

Another major challenge in both diagnosing and managing chronic pain stems from its complex and often multifactorial etiology. As discussed previously, chronic pain rarely arises from a single, isolated cause. Instead, it is frequently the result of an intricate interplay between biological, psychological, and social factors. Identifying the primary contributors to an individual's pain can be exceptionally difficult, particularly when multiple conditions are present. For example, an individual may have underlying osteoarthritis, coexisting neuropathic pain, and psychological distress, all of which contribute to their overall pain experience. Disentangling these contributing factors and determining which are the most relevant targets for intervention can be a lengthy and challenging process. Additionally, chronic pain often results in changes to the central nervous system, further complicating the picture. Central sensitization, which involves increased excitability of the nervous system, can lead to amplified pain responses and the development of widespread pain, even in the absence of ongoing tissue damage. These complex interactions make it difficult to develop universal diagnostic criteria or treatment protocols, emphasizing the need for personalized assessments that consider the unique circumstances of each patient (6). Table 1 provides a summary of the global epidemiology of chronic pain, outlining categories and key aspects.

Table 1: Global Chronic Pain Epidemiology

№	Category	Key Aspects
1.	Global Prevalence	Definition
1.1		Overall Prevalence
1.2		Demographic Trends
1.3		Regional Variations
2.	Key Risk Factors	Biological
2.1		Psychological
2.2		Social
2.3		Lifestyle
3.	Impact of Chronic Pain	Reduced Quality of Life (QOL)
3.1		Physical Disability
3.2		Mental Health
3.3		Socioeconomic Burden
4.	Management Challenges	Subjectivity of Pain
4.1		Multifactorial Etiology
4.2		Limited Treatment

Current treatment options for chronic pain, including pharmacological interventions, physical therapies, and psychological treatments, often have limited effectiveness and significant side effects. Many pain medications, such as opioids, provide only short-term pain relief and carry a high risk of addiction and adverse effects, including respiratory

depression. Nonsteroidal anti-inflammatory drugs (NSAIDs) can cause gastrointestinal issues and other complications, limiting their long-term use. Other pharmacological options, such as anticonvulsants and antidepressants, may have limited efficacy for specific types of pain and may also be associated with side effects. Physical therapies, while beneficial for some patients, often require active participation and may not be suitable for individuals with severe pain or mobility limitations. Psychological interventions, such as cognitive behavioral therapy (CBT), can be effective for managing pain-related distress and improving coping strategies, but may not directly address the underlying physiological mechanisms of pain. Furthermore, access to specialized pain management programs can be limited, particularly in underserved communities (17). The challenges associated with current treatment options underscore the urgent need for research into innovative therapies, including targeted pharmacotherapies, neurostimulation techniques, and regenerative approaches, that can address the underlying mechanisms of chronic pain and provide long-lasting relief with minimal side effects.

6 Conclusion

Chronic pain, as a pervasive and debilitating global health challenge, affects millions of individuals across all demographics, placing an immense burden on healthcare systems, economies, and the very fabric of society. This exploration of the epidemiology of chronic pain has illuminated the complex interplay of biological, psychological, and social factors that contribute to its development, highlighting the urgent need for a comprehensive and multidisciplinary approach to address this pervasive issue. Moving beyond a purely symptomatic approach, this conclusion underscores the necessity of a strategic framework focused on early intervention, improved access to effective treatments, robust public awareness campaigns, and continued investment in research. A shift in perspective from simply managing chronic pain to actively striving for its prevention and improved quality of life for those affected is paramount. The path forward requires a commitment from governments, healthcare providers, researchers, and communities to work collaboratively towards a future where chronic pain is effectively managed, and individuals can live healthier, more fulfilling, and productive lives. The preceding sections have demonstrated that chronic pain is far more than a simple symptom; it is a complex, multifaceted condition that significantly impacts individuals' physical, mental, and emotional well-being. The high prevalence of chronic pain across diverse populations, the intricate mechanisms underlying its chronicity, the diverse range of conditions associated with it, and the substantial socioeconomic burden it imposes, all highlight the urgent need for a more comprehensive and strategic response. Furthermore, the limitations of current treatment approaches, the challenges associated with access to care, and the persistent stigma surrounding chronic pain all underscore the need for significant improvements in how we understand and manage this condition.

Author Contributions

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Conflicts of Interest

The authors declare no competing interests.

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