



# Cognitive horizons in chronic pain: unraveling neuroscientific insights and innovative interventions for fibromyalgia

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Chronic pain is pervasive, affecting over 30% of the global population. It extends beyond mere physical discomfort and warrants further consideration as a disease with a dynamic interplay among physical, psychiatric, neuroscientific factors and biopsychosocial implications [1]. Illustrated by such conditions as fibromyalgia, a prominent contributor to chronic widespread pain, chronic pain involves mental and cognitive dimensions [2]. Recognizing the role of neuroplasticity factors in fostering resilience highlights their potential to mitigate the chronicity of pain, revealing the multifaceted nature of chronic pain and suggesting avenues to treat and manage intractable cases [3]. Recent articles in *European Archives of Psychiatry and Clinical Neuroscience* have sought to unravel nuanced realms that transcend physical manifestations of chronic pain, highlighting the interplay of mental and cognitive dimensions. Groundbreaking research on cognitive aspects of chronic pain has suggested innovative interventions within psychiatry and neuroscience.

The interplay between somatic and central nervous system mechanisms suggests that psychological processes, such as trauma and stress, can act synergistically with physical pathogenic processes [4]. The connection between pain sensation and mental activity is a significant aspect, exemplified

by research by Kim et al. [5] on synergistic effects of chronic pain and nonsuicidal self-harm, illuminating the intersection between physical and psychological pathogenic processes. Both depression and hopelessness influence pain sensitivity, underscoring the significance of adopting a comprehensive approach for chronic pain patients that encompasses mental health dimensions.

As we delve deeper into cognitive terrain, research by Ferrera et al. [6] revealed higher P2 amplitudes in fibromyalgia patients, based on electroencephalographic (EEG) recordings, particularly in individuals who carry the valine form of the catechol-*O*-methyltransferase (Val/Val COMT) genotype, suggesting a link between event-related potential indices of working memory dysfunction and genetic variations. These novel findings indicate that the Val/Val genotype may be a potential biological marker of working memory dysfunction in fibromyalgia. The implications of these findings extend to the prospect of tailored treatments that target cognitive dysfunction in chronic pain patients, emphasizing the importance of individualized approaches to enhance our understanding of mental aspects of chronic pain.

A neuroimaging study by Balducci et al. [7] explored abnormal functional neurocircuitry that underpins emotional processing in fibromyalgia, revealing heightened lateral occipital cortex activation and alterations of valence-dependent functional connectivity of the left pregenual anterior cingulate cortex. These findings underscore emotional dimensions of fibromyalgia and the critical need for precision therapies, including psychotherapeutic interventions and neuromodulation techniques. The significance of their study lies in its contribution to advancing our understanding of mental dimensions of chronic pain, offering valuable insights for tailored treatments, and paving the way for future longitudinal studies of neural changes that are associated with refined therapeutic interventions.

The narrative unfolds further with an exploration by Fernandes-Magalhaes et al. [8] of the potential efficacy of

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attentional bias modification (ABM) protocols in fibromyalgia patients. The observed reduction of P2 amplitudes signifies early attentional resource modulation, suggesting ABM's impact on automatic allocation to pain-related stimuli. Conversely, heightened N2a amplitudes reflect enhanced attentional control mechanisms, highlighting dual cognitive processes that are influenced by ABM in fibromyalgia. These findings highlight the clinical relevance of ABM to shaping attentional bias and mitigating anxiety and depressive symptoms. This neurocognitive perspective has significant value in the emerging field of ABM in fibromyalgia, laying the groundwork for further research and emphasizing its potential as an adjunctive therapeutic strategy in psychiatry for chronic pain patients.

A systematic review by Torres et al. [9] synthesizes diverse neurofeedback protocols, offering a comprehensive perspective on their impact on psychological variables and overall health in fibromyalgia patients. Their review examined the efficacy of EEG neurofeedback as a treatment for fibromyalgia, providing a comprehensive analysis of diverse protocols, designs, and mechanisms. The reviewed studies indicated significant variability in EEG-neurofeedback protocols, with differences in measurement channels, frequencies, and reinforcement types. The mechanisms that underlie EEG-neurofeedback treatments are diverse, ranging from operant conditioning to alternative methods like EEG-driven stimulation and low-energy neurofeedback. Despite heterogeneity of the results, consistent positive outcomes were observed across studies, indicating improvements in pain, general health, symptom severity, and psychological well-being. The review highlights current limitations and calls for standardized approaches to advance the field, urging researchers and clinicians to reflect on the potential role of neurofeedback within the broader framework of a multi-pronged approach for chronic pain patients.

As we converge into an integrated understanding, academic investigations accentuate the imperative of bridging the gap between cognitive and somatic aspects of chronic pain. From genetic insights to neuroimaging revelations and innovative interventions, a roadmap is being drawn to better understand the symbiotic relationship between chronic pain, mental health, and innovative interventions for fibromyalgia and chronic pain at large within psychiatry and neuroscience [10]. This holistic approach seeks to redefine the treatment landscape and offer hope and direction to improve the lives of chronic pain patients. As scholars, we are committed to scrutinizing this intricate interplay, from synergistic effects

of depression and chronic pain to genetic predisposition that influences cognitive resilience in fibromyalgia. We endeavor to advance our collective understanding of fibromyalgia, refine therapeutic strategies, and improve the quality of life of those who must endure chronic pain conditions.

## Declarations

**Conflict of interest** Lin Lu is Editor at European Archives of Psychiatry and Clinical Neuroscience. The authors declare no competing interests.

## References

1. Cohen SP, Vase L, Hooten WM (2021) Chronic pain: an update on burden, best practices, and new advances. *Lancet* 397:2082–2097. [https://doi.org/10.1016/S0140-6736\(21\)00393-7](https://doi.org/10.1016/S0140-6736(21)00393-7)
2. Pinto AM, Geenen R, Wager TD et al (2023) Emotion regulation and the salience network: a hypothetical integrative model of fibromyalgia. *Nat Rev Rheumatol* 19:44–60. <https://doi.org/10.1038/s41584-022-00873-6>
3. Weigl M, Beeck S, Kraft E et al (2024) Multidisciplinary rehabilitation with a focus on physiotherapy in patients with post Covid19 condition: an observational pilot study. *Eur Arch Psychiatry Clin Neurosci*. <https://doi.org/10.1007/s00406-023-01747-y>
4. Sun J, Yan W, Zhang XN et al (2020) Polygenic evidence and overlapped brain functional connectivities for the association between chronic pain and sleep disturbance. *Transl Psychiatry* 10:252. <https://doi.org/10.1038/s41398-020-00941-z>
5. Kim DJ, Job A, Gokarakonda S et al (2022) Synergistic effect of chronic pain and nonsuicidal self-harm on pain sensitivity. *Eur Arch Psychiatry Clin Neurosci* 272:371–380. <https://doi.org/10.1007/s00406-021-01283-7>
6. Ferrera D, Gómez-Esquer F, Peláez I et al (2023) Working memory dysfunction in fibromyalgia is associated with genotypes of the catechol-O-methyltransferase gene: an event-related potential study. *Eur Arch Psychiatry Clin Neurosci* 273:25–40. <https://doi.org/10.1007/s00406-022-01488-4>
7. Balducci T, Garza-Villarreal EA, Valencia A et al (2024) Abnormal functional neurocircuitry underpinning emotional processing in fibromyalgia. *Eur Arch Psychiatry Clin Neurosci* 274:151–164. <https://doi.org/10.1007/s00406-023-01578-x>
8. Fernandes-Magalhaes R, Carpio A, Ferrera D et al (2023) Neural mechanisms underlying attentional bias modification in fibromyalgia patients: a double-blind ERP study. *Eur Arch Psychiatry Clin Neurosci* xxx. <https://doi.org/10.1007/s00406-023-01709-4>
9. Torres CB, Barona EJJ, Molina MG et al (2023) A systematic review of EEG neurofeedback in fibromyalgia to treat psychological variables, chronic pain and general health. *Eur Arch Psychiatry Clin Neurosci*. <https://doi.org/10.1007/s00406-023-01612-y>
10. Nesse RM (2023) Evolutionary psychiatry: foundations, progress and challenges. *World Psychiatry* 22:177–202. <https://doi.org/10.1002/wps.21072>