Pain and Cognition: A Narrative Review of the Effects of Chronic Pain on Neuropsychological Functioning

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Background

- It is widely established that chronic pain has a negative effect on neurocognitive functioning, in both adult and pediatric populations. These impairments are specifically strong in the areas of memory, processing speed, attention, and executive functions, and particularly among older patients and those with fibromyalgia.
- The exact mechanism explaining the relationship between cognition and pain has yet to be determined. Two main hypotheses are posited: 1) pain is distracting and removes focus from the task at hand, resulting in decreased cognitive performance, and 2) the neural systems involved in both pain and cognition are closely linked and may even modulate one another reciprocally.
- The relationship is complex in nature and it is important to consider factors that could be potential mediators or moderators of the relationship, such as age, sex, cognitive load, fatigue, opioid use, pain intensity, pain location, sleep disturbance, fatigue, tendencies toward somatization and/or somatic vigilance, and emotional state. These factors have all been shown to interact with cognition on some level, whether they are independently associated with cognitive dysfunction or, in tandem with pain, disrupt cognitive processes.

Fibromyalgia

- Commonly referred to as "FibroFog", patients often report cognitive difficulties.
- Research shows that patients with fibromyalgia exhibit significantly worse performance on neuropsychological testing than healthy controls, specifically in regard to selective attention, response inhibition, short- and long-term memory, and executive functions of set-shifting and updating.

Migraine

- Deficits in attention, language use, and visuospatial skills, even when controlling for other factors involved in the relationship, such as mood and medications. However, it is notable that the medication topiramate, which is used to treat chronic migraine, is associated with additional deficits in attention.

Traumatic Brain Injury

- Research in this area is very limited, as the injury can potentially be a precipitant of both the pain and the neurocognitive impairment, making it hard to isolate these effects. However, the literature does show that veterans with TBI and chronic pain are likely to experience cognitive impairment as well, specifically regarding attention and memory.

Rheumatoid Arthritis

- Deficits in attention, working memory, visual and verbal memory, visuospatial processes, and executive function

General chronic pain in pediatric populations

- Deficits in executive functioning, specifically sustained attention and working memory

Complex Regional Pain Syndrome (CRPS)

- Patients with CRPS show distorted body representation, such as perceiving the affected limb as being larger, smaller, lighter, or heavier relative to its true size and weight. This distortion can also include a lost sense of ownership of one's limb, or intense feelings of disgust or hatred towards the affected limb.
- Patients also report symptoms resembling hemispatial neglect, which follows a brain lesion and involves attention deficits that are specific to items in one side of space. However, the performance of people with CRPS on standard neuropsychological tests does not fully support this symptom, leading researchers to believe it may be a result of exaggerated "pseudoneglect."
- Impairment of non-spatially- lateralized higher cognitive functions, such as working memory, verbal learning and memory, and nonlateralized attention, are present but not unique to CRPS, and may be explained as an effect of the pain, similar to other chronic pain conditions.

Novel Treatments: Recent Research

The following treatments have recently been shown to improve cognitive functioning chronic pain patients:

- Virtual Reality (VR)**
 - The technological tool was used in a rehabilitative way by stimulating realistic environments and real-life exercises that were tailored to the specific needs of the patient. This technique has been shown to engage neuronal circuits which promote learning and recovery, and the results of this study showed that VR-based motor training was able to improve chronic pain-related cognitive dysfunction.
- Computerized cognitive training**
 - Computerized game-like cognitive training exercises were successful in enhancing cognitive functioning in patients with chronic pain, but more research needs to be done to determine whether the improvements will transfer to functional and clinical outcomes.
- Transcranial direct current stimulation combined with working memory training**
 - To enhance cognitive functions in patients with fibromyalgia, anodal transcranial direct current stimulation (tDCS) was performed over the dorsolateral pre-frontal cortex (DLPFC) while the patients also underwent a working memory training program. The results showed significant improvement in memory and executive functions, which has clinical relevance for top-down treatment approaches in fibromyalgia.

Future Research

- Further investigation into the role that moderators and mediators of the relationship between pain and cognition play to more efficiently target cognitive complaints
- Better understand the way chronic pain affects more complex executive skills, such as self-monitoring
- Further examine neural mechanisms and pathways common to both pain perception and neurocognitive functioning
- More longitudinal studies to track cognitive changes over time in response to a treatment in order to better understand the effects of different pain treatments and management programs

Clinical Implications

- Clinician should carefully evaluate patient with chronic pain for other factors, such as cognitive and emotional well-being.
- Pain treatment should also target associated symptoms, such as low-mood, sleep issues, and cognitive impairment.
- Teachers and school psychologists should be aware of the effects of chronic pain on cognitive functioning, and multidisciplinary treatments for children and adolescents experiencing chronic pain can be further developed to incorporate cognitive training and help students achieve academic success.
- When assessing cognitive functioning in patients with chronic pain, the clinician should try to reduce discomfort by ensuring a comfortable seating position and allowing frequent breaks. The effects of the pain on factors such as mood and sleep should also be taken into consideration when interpreting the results of the neuropsychological tests.

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