

**THE RELATIONSHIP BETWEEN CHRONIC PAIN AND COGNITION**

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**INTRODUCTION**

- The International Association for the Study of Pain (IASP) defines pain as:
  - “an unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage”
- Pain is often considered a multifaceted experience to include emotion, attitudes, and other perceptual influences.

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ACUTE	CHRONIC
Specific neuroanatomic pathways that serve to mediate the effects of the injury	Less discrete neuroanatomic pathways
Serve to communicate information that holds a survival value that then instigates protective physiological response and cues the need for some sort of corrective action to support healing	Transmits information that may serve to elongate the protective response albeit with reduced adaptive value
Time-limited	Persists long after the injury takes place (i.e., beyond three to six months)
In general, an absence of significant psychosocial or behavioral changes disproportionate to pain intensity	Oftentimes, significant behavioral and emotional changes

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EPIDEMIOLOGY OF CHRONIC PAIN

- Institute of Medicine reported that more than a 100 million Americans suffer from chronic pain
- According to the National Institute of Health, the direct and indirect cost of persistent pain is estimated at \$560-635 billion dollars annually
  - This far exceeds the cost of the other six major diseases including cardiovascular (309), neoplasms (243), injury and poisoning (205), endocrine, nutrition, and metabolic (127), gastrointestinal (112), and pulmonary (112).
- Approximately 20% of adults less than age 65 have some form of chronic pain in the United States.
- Approximately 40% of older adults have some form of chronic pain in the United States.

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EPIDEMIOLOGY OF CHRONIC PAIN CONTD.

- A higher prevalence of chronic pain and high impact chronic pain was observed among the following:
  - Women
  - Older adults
  - Previously but not currently employed adults
  - Adults living in poverty
  - Adults with public health insurance
  - Rural residents
- Adjusted for age, the prevalence of chronic pain and high-impact chronic pain was significantly lower among adults with a bachelor's degree or higher

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EPIDEMIOLOGY OF CHRONIC PAIN CONTD.

- Non-Hispanic white adults had a significantly higher age-adjusted prevalence of chronic pain compared to all other racial and ethnic subgroups
- Veterans had a significantly higher age-adjustment prevalence of chronic pain compared to nonveterans
- Adults 65 and older with Medicare and Medicaid had higher age-adjusted prevalence of both chronic and high-impact chronic pain than adults with all other types of coverage

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### PREVALENCE OF PEDIATRIC CHRONIC PAIN

- Approximately 20-35% of children are affected by pediatric chronic pain worldwide.
- More than 10% of hospitalized children show features of chronic pain
- The total costs to society incurred by care for children and adolescents with chronic pain has been estimated at \$19.5 billion annually in the United States.
- Implications of untreated pain in childhood:
  - 17% of adults with chronic pain reported a history of chronic pain in childhood
    - 80% indicated the pain in childhood persisted into adulthood

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### CHRONIC PAIN PRIMARY AND SECONDARY DIAGNOSES

- Chronic Pain Due to Trauma
- Other Chronic Pain
- Chronic Pain Syndrome

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### CLASSIFICATION OF CHRONIC PAIN PROPOSED FOR ICD-11

Chronic Primary Pain	Chronic Cancer Pain	Chronic Postsurgical and Posttraumatic Pain	Chronic Neuropathic Pain
Chronic Headache and Orofacial Pain	Chronic Visceral Pain	Chronic Musculoskeletal Pain	

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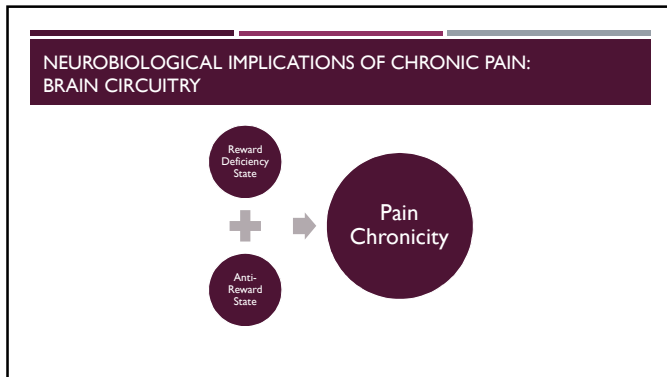
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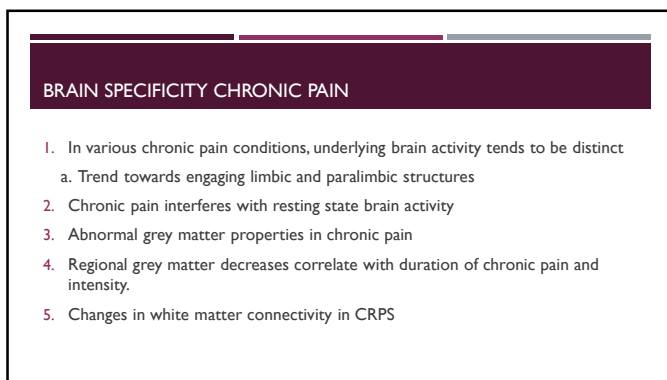
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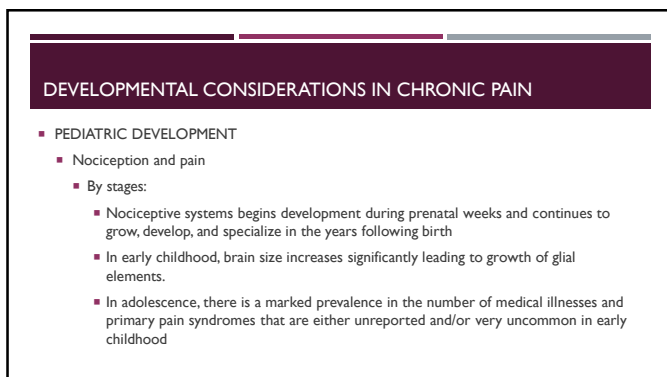
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### DEVELOPMENTAL CONSIDERATIONS IN CHRONIC PAIN

- Geriatric considerations
  - Homeostenosis vs homeostasis
  - Central nervous system changes
  - Decreased endogenous pain inhibition with aging
  - Mobility impairment
- Age-related differences in the production, uptake and receptor binding of pain-related neurotransmitters.



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### PSYCHOLOGICAL COMORBIDITIES IN CHRONIC PAIN



- Anxiety
- Depression
- Alcohol Use Disorder
- Posttraumatic Stress Disorder
- Bipolar disorders

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### DEPRESSION AND ANXIETY IN CHRONIC PAIN

- 70% of patients with chronic pain also experience depression and anxiety
- Bidirectional association thought to be due to:
  - Social isolation
  - Treatment complications
  - Shared underlying cognitive and behavioral processes

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### CHRONIC PAIN AND OPIOID ABUSE

- Opioid analgesics are now the most commonly prescribed class of medications in the United States
- These medications exert analgesic effects mainly by binding to mu-opioid receptors.
  - These receptors are concentrated in brain regions that regulate pain perception
- Patient Factors:

	OVERDOSE	ADDICTION
Age >65	YES	-
Depression	YES	YES
Substance-use disorder	YES	YES
Adolescence	-	YES
History of overdose	YES	-

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### EFFECTS OF OPIOID USE ON COGNITION

- Opioids impact seems most prominent in the first few days of use, particularly on timed psychomotor tasks
- There are inconsistent findings regarding potential cognitive dysfunction associated with long-term use
- Prescription opioid use is a risk factor for delirium
- Individuals with heaviest opioid use had slightly higher dementia risk than individuals with little or no use, but this association was not statistically significant (HR 1.26, 95% CI 0.99–1.61)

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### COGNITIVE IMPAIRMENT IN CHRONIC PAIN

It is estimated that at least 50% of people living with pain report cognitive concerns.

According to Baker et al. (2017), self-reported cognitive concerns concurred with objectively measured performance, independent of age, education, and catastrophizing.

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**COGNITIVE IMPAIRMENTS IN ADULTS WITH CHRONIC PAIN: EF**

Attention & Executive Functioning	Selective attention
	Sustained attention
	Working Memory
	Cognitive flexibility
	Reward sensitivity
	Processing and Psychomotor Speed

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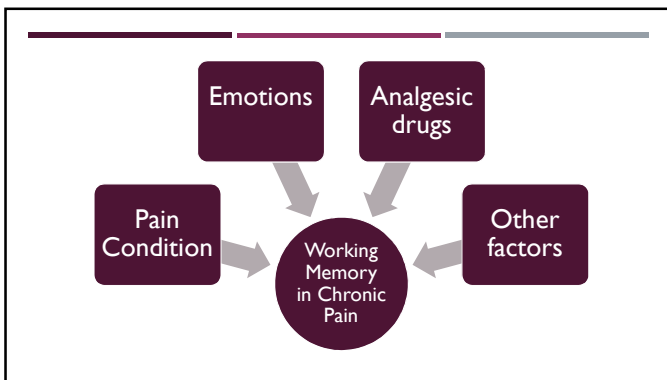
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**COGNITIVE IMPAIRMENTS IN ADULTS WITH CHRONIC PAIN: L&M**

Learning & Memory	Short-term memory
	Learning
	Retention
	Implicit Memory
	Conditioned learning/extinction

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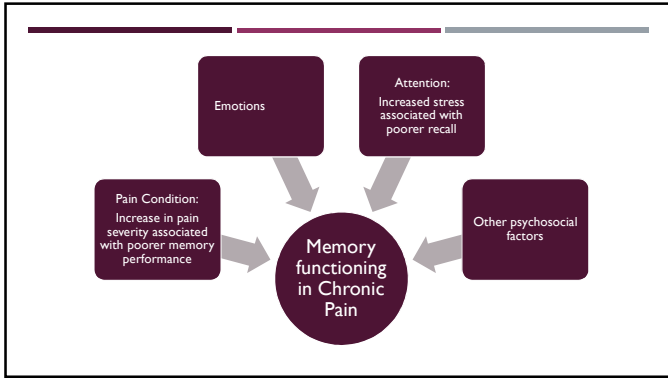
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**COGNITIVE DEFICITS IN PEDIATRIC PATIENTS WITH CHRONIC PAIN**

- Adolescents with chronic pain have lowered performance on measures of executive functioning.
  - Sustained attention
  - Working memory
- Pain intensity, duration, and catastrophizing were significantly related to their performance on neurocognitive testing.

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**MEDIATING AND MODERATING VARIABLES IN THE RELATIONSHIP BETWEEN CHRONIC PAIN AND COGNITION**

- Mood symptoms
- Medication side effects
- Type of chronic pain condition
- Relationship between chronic pain and traumatic brain injury
- Sleep dysregulation

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**MEDIATING AND MODERATING VARIABLES IN THE RELATIONSHIP BETWEEN CHRONIC PAIN AND COGNITION**

- Intensity of the chronic pain
- Cognitive load
- Age
- Chronicity of pain



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**HYPOTHESIZED MECHANISMS UNDERLYING COGNITIVE IMPAIRMENT IN CHRONIC PAIN**

- Limited Resources Theory
- Narrow Attentional Resources Hypothesis
- Maladaptive Plasticity
- Adaptive Plasticity
  - Normalization of cortical thickness in anterior cingulate and dlPFC following resolution of pain
  - As seen in an investigations by Ceko et al. as well as Seminowicz et al.

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**THE IMPACT OF COGNITIVE DEFICITS IN CLINICAL OUTCOMES**

- Cognitive inefficiencies can impact a patient's response to treatment
  - Investigations by Johnco et al and D'Alcante et al demonstrated the integral role of cognitive flexibility in cognitive restructuring
- Link between cognitive functioning and the endogenous pain modulatory systems
- Link between cognitive functioning and the pain experience

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**TREATMENT APPROACHES TO ADDRESS COGNITION IN THE CHRONIC PAIN POPULATION**

I. Assessment

- Attention and information processing speed (TMT, SDM)
- Working memory (PASAT, spatial span)
- Memory (RAVLT, RCFT)
- Executive Functions
  - Cognitive inhibition (Stroop)
  - Mental flexibility (WCST)
  - Verbal fluency (COWAT)



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**TREATMENT APPROACHES TO ENCHANCE COGNITIVE FUNCTIONING IN THE CHRONIC PAIN POPULATION**

2. Psychoeducation

- Education regarding the patient's deficits and why said deficits may have occurred
- Education regarding causes, prevalence, and maintenance factors in chronic pain
- Addressing misconceptions

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**TREATMENT APPROACHES TO ENCHANCE COGNITIVE FUNCTIONING IN THE CHRONIC PAIN POPULATION**

3. Compensatory Strategie

- Internal
- External



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TREATMENT APPROACHES TO ENCHANCE COGNITIVE FUNCTIONING IN THE CHRONIC PAIN POPULATION

4. Restorative approaches

- Cognitive retraining
- Computerized Cognitive Training
- “Real-world” types of mental stimulation

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TREATMENT APPROACHES TO ENCHANCE COGNITIVE FUNCTIONING IN THE CHRONIC PAIN POPULATION

5. Psychotherapy

- Cognitive Behavior Therapy
  - Often encompasses the following techniques:
    - Relaxation and mindfulness
    - Stress management
    - Countering fear avoidance behavior
  - Also helpful in addressing sleep hygiene
- Neurocognitive benefits to participating in CBT

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TREATMENT APPROACHES TO ENCHANCE COGNITIVE FUNCTIONING IN THE CHRONIC PAIN POPULATION

6. Physical activity

7. Optimizing medication regimen

8. Neuromodulation



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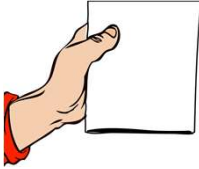
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**STRATEGIES TO ENHANCE TREATMENT DELIVERY**

- Modification in how the targets are presented:
  - Use of handouts
  - In-session demonstrations
  - Supplement with technological aids (e.g., apps)



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**LIMITATIONS AND FUTURE DIRECTIONS**

- Control for confounding variables (e.g., opioid analgesic use)
- Include a pain-free comparison conditions
- Include larger sample sizes
- Additional research to clarify the role of pain intensity and chronicity on cognitive functioning
- Future research should systematically investigate cognitive interventions in this population to clarify utility

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**CONCLUSIONS**

- Chronic pain has significant clinical, social, and economic implications
- Multiple systems interact that are both physiological and psychological in the transition from acute to chronic pain
- Morphological studies demonstrate multiple changes to brain structure at spatial and temporal scales.
- Some of these changes are reversible following the cessation of the chronic pain

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**CONCLUSIONS**

- Cognitive deficits in this population include:
  - Attentional capacity
  - Processing speed
  - Psychomotor speed
  - Memory
  - Executive functioning
- Several variables may moderate and/or mediate this relationship (e.g., mood symptoms, pain intensity, analgesic use)



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**CONCLUSIONS**

- Treatment considerations in pain management should account for these potential deficits
- This can include:
  - Initial neuropsychological assessment
  - Psychoeducation
  - Compensatory strategies
  - Medication optimization
  - Cognitive Behavior Therapy
  - Physical activity

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