

severity, and pain interference [75]. The effects of MORE on pain were statistically mediated by the capacity to reappraise pain as innocuous sensory information, again suggesting that mindfulness training modifies contextual evaluations of nociceptive information. In a second RCT, MORE was evaluated as a prophylactic intervention for long-term opioid-treated chronic pain patients at risk of developing opioid misuse [117]. Ninety-five patients were randomized to 8 weeks of MORE or to a support group intervention, after which MORE-treated patients reported significantly greater improvements in an array of positive psychological functions and reductions in pain severity and opioid misuse risk than support group patients at 3-month follow-up. The effects of MORE on reducing pain severity were statistically mediated by increases in positive psychological functioning and, most notably, by mindfulness-induced mental states and enhanced capacity to savor positive experiences. These clinical effects parallel recent EEG data from a series of randomized controlled experiments demonstrating that MORE increases neurophysiological responsivity to naturally rewarding, positive stimuli and decreases neurophysiological reactivity to opioid-related cues [118]. However, the underlying neural mechanisms supporting the effect of MORE on reducing pain and opioid misuse remain unknown. While more research is needed to confirm the precise neural mechanisms that modulate these processes, the ability of mindfulness meditation to not only target pain via multiple unique non-opioidergic modulatory pathways but to also mitigate the psychological risks of developing opioid use disease makes it an important candidate for further research.

### Future Directions for Mindfulness-Based Pain Therapies

The neuroscience of mindfulness-based pain relief is in its infancy, and yet it has already proven capable of expanding the repertoire of known neural modulatory pain pathways and of shedding light on the complex affective and psychosocial components of chronic pain. The vast number of global chronic pain sufferers as well as the health and social risks of opioid use disorder underscores the potential value of developing validated self-administrable mind-body therapies that target pain multidimensionally via several unique neuromodulatory pathways. The great variability within mindfulness meditation techniques as well as the biopsychosocial complexity of chronic pain conditions, however, requires researchers to continue to apply the highest experimental standards to find and fine-tune the clinically relevant tools we need to produce long-lasting improvements in chronic pain management. By altering the meaning, interpretation, and appraisal of nociceptive information on its way to constructing the subjective experience of pain, mindfulness-based approaches may play an

important role in the integrative therapeutic regimens capable of stemming the rising tide of chronic pain.

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### Compliance with Ethical Standards

**Conflicts of Interest** The authors declare that they have no conflict of interest.

**Human and Animal Rights and Informed Consent** This article does not contain any studies with human or animal subjects performed by any of the authors.

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