Demystifying meditation -- brain imaging illustrates how meditation reduces pain

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Meditation produces powerful pain-relieving effects in the brain, according to new research published in the April 6 edition of the *Journal of Neuroscience*.

"This is the first study to show that only a little over an hour of meditation training can dramatically reduce both the experience of pain and pain-related brain activation," said Fadel Zeidan, Ph.D., lead author of the study and post-doctoral research fellow at Wake Forest Baptist Medical Center.

"We found a big effect - about a 40 percent reduction in pain intensity and a 57 percent reduction in pain unpleasantness. Meditation produced a greater reduction in pain than even morphine or other pain-relieving drugs, which typically reduce pain ratings by about 25 percent."

For the study, 15 healthy volunteers who had never meditated attended four, 20-minute classes to learn a meditation technique known as focused attention. Focused attention is a form of mindfulness meditation where people are taught to attend to the breath and let go of distracting thoughts and emotions.

Both before and after meditation training, study participants' brain activity was examined using a special type of imaging -- arterial spin labeling magnetic resonance imaging (ASL MRI) -- that captures longer duration brain processes, such as meditation, better than a standard MRI scan of brain function. During these scans, a pain-inducing heat device was placed on the participants' right legs. This device heated a small area of their skin to 120° Fahrenheit, a temperature that most people find painful, over a 5-minute period.

The scans taken after meditation training showed that every participant's pain ratings were reduced, with decreases ranging from 11 to 93 percent, Zeidan said.

At the same time, meditation significantly reduced brain activity in the primary somatosensory cortex, an area that is crucially involved in creating the feeling of where and how intense a painful stimulus is. The scans taken before meditation training showed activity in this area was very high. However, when participants were meditating during the scans, activity in this important pain-processing region could not be detected.

The research also showed that meditation increased brain activity in areas including the anterior cingulate cortex, anterior insula and the orbito-frontal cortex. "These areas all shape how the brain builds an experience of pain from nerve signals that are coming in from the body," said Robert C. Coghill, Ph.D., senior author of the study and associate professor of neurobiology and anatomy at Wake Forest Baptist.

"Consistent with this function, the more that these areas were activated by meditation the more that pain was reduced. One of the reasons that meditation may have been so effective in blocking pain was that it did not work at just one place in the brain, but instead reduced pain at multiple levels of processing."

Zeidan and colleagues believe that meditation has great potential for clinical use because so little training was required to produce such dramatic pain-relieving effects. "This study shows that meditation produces real effects in the brain and can provide an effective way for people to substantially reduce their pain without medications," Zeidan said.

Provided by Wake Forest Baptist Medical Center