

Key Points

1. Chronic pain has many negative effects, including depression, anxiety, and cognitive impairments
2. fMRI is an imaging technique which can show the blood flow to specific areas of the brain while a person is performing a task
3. Study used fMRI to compare brain activity of chronic pain patients and healthy controls during a simple task
4. Both groups showed the same level of increased activity during the task, but the pain patients showed less decreased activity in certain areas
5. Authors believe that the persistent perception of pain interferes with the natural balance of activity in the brain, known as the Default Mode Network
6. There are many critics of fMRI in general who believe it does not accurately reflect brain activity

Definitions

chronic pain - pain that persists over a long period of time, usually defined as longer than 3-6 months

default mode network (DMN) - describes the state of the brain at rest, which involves some regions becoming more active, and some regions becoming less active

fMRI - functional magnetic resonance imaging; non-invasive imaging device which can show blood flow to specific brain areas, which is used as an indirect measure of brain activity

cerebellar tonsils - portion of the cerebellum located at the bottom, so named because of their shape

cerebellum - part of the brain located at the bottom of the skull, near the opening to the spinal area; important for muscle control, movement, and balance

Chronic Pain Disrupts The Brain's Natural Activity State

March 31, 2008 -- Functional MRI (fMRI) is an imaging technology that can show the amount of blood flow to specific brain regions while a person is performing a task (Figure 1). Despite some criticism it has been used for several years to show which brain regions are involved in different types of cognitive functions, with the theory being that the amount of blood flow is an indirect indication of brain activity.

Some scientists dispute the value of fMRI and believe that just measuring blood flow is not a good indicator of brain activity. They point out that even if it is valid, it only shows where something is occurring, not how or why. They also think that fMRI misses the boat on revealing the distributed nature of most brain functions.

While some researchers are trying to develop even more advanced brain imaging techniques which can measure the amounts of specific electro-chemical activity, fMRI continues to be used to study brain function. Along these lines, a group of pain researchers from Northwestern University recently published a study which might shed some light on how chronic pain can interfere with cognitive functioning. The researchers (Baliki et al) discussed their findings in the February, 2008 issue of the Journal of Neuroscience.

Research has documented the numerous negative effects of chronic pain, including lower overall health, elevated blood pressure, depression, anxiety, financial hardship, and most relevant to this article, cognitive impairments. Many patients suffering from chronic pain have anecdotally reported problems with concentration, focus, and decision making, and now the Northwestern study has provided clues, via fMRI, as to why this may be. Specifically, the researchers found that chronic pain disrupts the natural resting state of the brain, known as the Default Mode Network (DMN).

The Default Mode Network refers to those brain regions which are active during rest. When the brain is focused on a specific task, depending on the type of task, different regions become active and others become less active. Similarly, when the brain is at rest, certain regions show increased activity and other regions show decreased activity. This balance of increased and decreased activity is known what comprises the Default Mode Network. Previous research has shown that conditions such as autism, Alzheimer's, depression, and ADD can disrupt the balance of activity of the DMN.

In order to study the impact of chronic pain on the DMN, the researchers recruited 15 people suffering from chronic back pain (8 men and 7 women) and 15 healthy controls (also 8 men and 7 women). Then, functional MRI was used to image their brains while performing a simple task which involved tracking the height of a bar as it moved with a modified joystick. As expected, when the scientists looked at the fMRI images, they found that during the task certain brain regions showed an increase of activity while others showed a decrease in activity.

However, when they compared the chronic pain patients to the healthy controls, they found that the brain regions that show decreased activity in the healthy controls, did not show as much of a decrease in activity in the pain patients. In other words, when presented with a task, the brain of a healthy person will activate certain areas to perform the task and quiet other areas in effect to not interfere with the task. However, with chronic pain patients, this study showed that the brain was not able to quiet the regions it needed to.

This is illustrated in Figure 2 below. The red represents increased activity, while the blue represents decreased activity. During the simple task, both the normal controls and the chronic pain patients had similar levels of increased activity, but the chronic pain patient had less decreased activity. This difference is illustrated in the picture on the right.

Figure 2: Group Average fMRI During Task
Normal Chronic Pain Difference



Based on their results, the authors believe that chronic pain, because it is always present as a feeling in the brain, makes it difficult for the brain to lower the activity level of certain areas. This in turn disrupts the natural balance of the Default Mode Network and may interfere with certain brain functions.

It is important to note however, that the authors do not offer an explanation of why or how this occurs and that at least with this simple task the chronic pain patients performed as well as the healthy controls.

cerebrospinal fluid (CSF) - clear liquid in the brain and spinal cord, acts as a shock absorber

Chiari malformation I - condition where the cerebellar tonsils are displaced out of the skull area into the spinal area, causing compression of brain tissue and disruption of CSF flow

decompression surgery - general term used for any of several surgical techniques employed to create more space around a Chiari malformation and to relieve compression

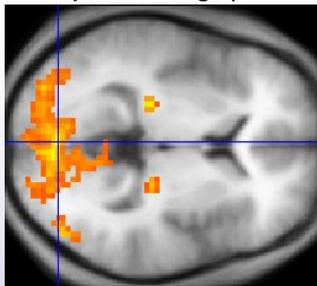
syringomyelia - condition where a fluid filled cyst forms in the spinal cord

Source

Baliki MN, Geha PY, Apkarian AV, Chialvo DR. [Beyond feeling: chronic pain hurts the brain, disrupting the default-mode network dynamics.](#) J Neurosci. 2008 Feb 6;28(6):1398-403.

Despite the criticisms aimed towards fMRI in general, and the limitations of this particular study, it is interesting to get a glimpse of the effect that chronic pain has on the brain.

Figure 1: Sample fMRI Image (from Wikipedia)



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