Neuroscience: Does meditation improve the brain?

Subhadeep Dutta Gupta, Research scholar in Neurobiology from NIMHANS, Bengaluru.
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Being a scholar of Neurophysiology from NIMHANS (where extensive work on the field of '**Meditation and Brain effects**' has been done as well as currently undergoing), I will try to answer the question.

Yes, Meditation definitely changes the brain for the positive.

Meditation can be conceptualized as a family of complex emotional and attentional regulatory training practices developed for various ends. Meditation is a training in awareness which produces definite changes in perception, attention, and cognition. It is also recognized as a specific consciousness state in which deep relaxation and increased internalized attention co-exist.

Proficient meditative practices help to integrate the brain functions, regulate various physiological mechanisms resulting in a state of **mental and physical wellbeing**. Mindfulness meditation has also been suggested to alter biological processes such as those in the **brain and immune system**, to alter **central and autonomic nervous system** interactions in a positive manner, and to **improve attention.**

1) Meditation and alteration in brain structure:

Studies show that active practitioners of meditations, including Zazen, Samatha and Vipassana have **larger gray matter (GM) density in the orbitofrontal cortex** (OFC), which is related to emotional regulation processing and **greater cortical thickness** in the **middle and superior frontal cortices**, which is associated with attention processing.

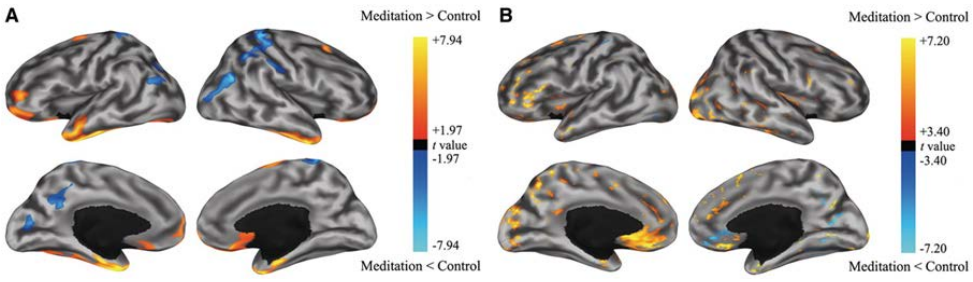
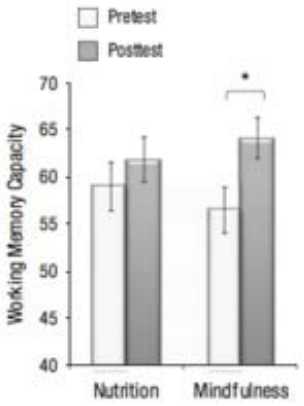


Fig: *Regional maps showing the statistical differences (A) in cortical thickness and (B) in FA between meditation practitioners and control subjects.*

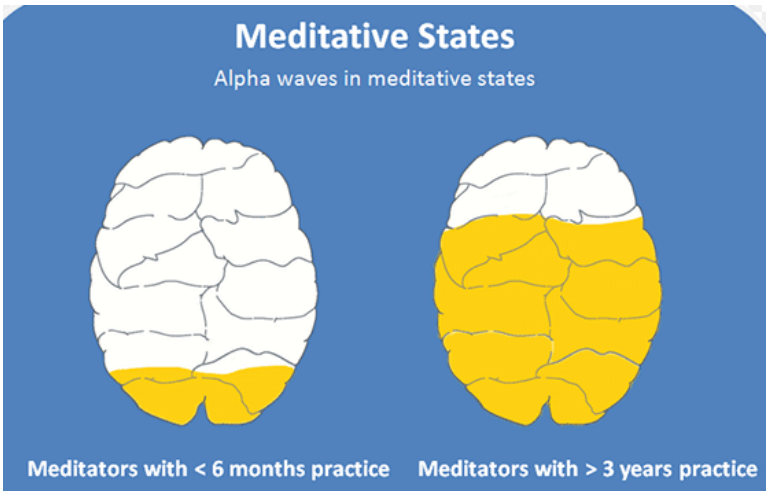
Meditators have **thicker cortex** in the anterior portions of the brain, located in the frontal–temporal region, including bilateral ventromedial PFC, superior frontal cortex and middle and interior temporal cortices than controls. Meditators compared with controls had **thinner cortex** in the posterior portions of the brain, located in parietal–occipital region, including bilateral postcentral and inferior parietal cortices and left Posterior Cingulate Cortex.

2) Effect of Meditation on Attention and Pain:

Researchers from Massachusetts General Hospital (MGH), Harvard Medical School and the Massachusetts Institute of Technology reported that that people trained to meditate over an eight-week period were better able to control a specific type of brain waves, called **alpha rhythms**. Alpha waves flow through cells in the brain's cortex, where sensory information is processed. The alpha waves help suppress irrelevant or distracting sensory information. It led to the discovery that mindfulness meditators more quickly adjust the brain wave that screens out distraction which explains their superior ability to rapidly remember and incorporate new facts. Mindfulness meditation has been reported to enhance numerous mental abilities, including rapid memory recall (more effective and significant than proper nutrition).



In pain sufferers who meditate, the beneficial effects may come from an ability to essentially turn down the volume on pain signals. They learn to be aware of where their attention is focused and not get stuck on the painful area. The subjects trained in meditation also reported that they felt **less stress** than the non-meditators.



3) Meditation and Autonomic Nervous System:

Meditation practices help to bring about **sympatho-vagal balance with parasympathetic predominance** among experienced meditators and also in novice meditators with less practice. Vipassana meditation practices help to retain the **flexibility of autonomic activity during different stages of sleep**.

Further, heart rate variability evaluation during REM sleep showed higher sympathetic activity in meditators than in controls. This higher sympathetic activity in meditators was effectively buffered by parasympathetic activity unlike the non-meditating controls (unpublished data). These studies have demonstrated a greater insight into the modulatory effect of meditation practices on autonomic functions during sleep.

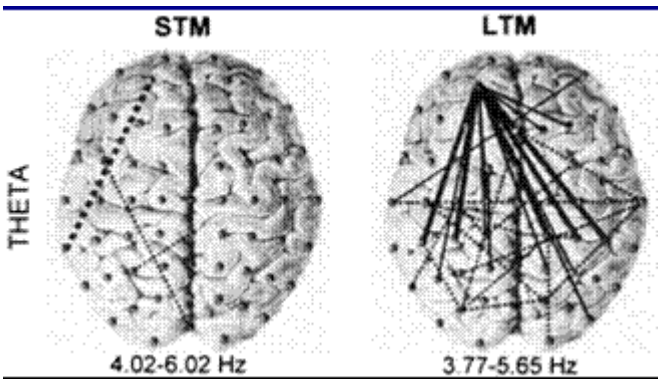


Fig: *Enhanced Fronto-Parietal theta activation in Long Term Meditators (LTM) compared to the Short Term Meditators (STM)*

Meditation practices are associated with **enhanced frontal midline theta activity**. The frontal midline theta activity originates from the **anterior cingulate cortex** and

controls the parasympathetic activity. Vipassana meditation practices **activates the anterior cingulate cortex and hence modulated the parasympathetic activity during sleep**. These reports are suggestive of a positive modulatory role of meditation in sleep through autonomic functions.

Meditation practices **activate prefrontal cortex, fronto-limbic, fronto-parietal neural networks and limbic and paralimbic cortices** associated with sympathetic arousal. Meditation practices activate structures like insula, anterior cingulate, and hypothalamus and bring about autonomic and humoral changes.

4) Meditation and Hormonal secretion:

Meditation practices regulate the **hypothalamo-pituitary-adrenal (HPA) Axis** and thereby the **Cortisol** and **Catecholamine** levels. Meditation techniques were also known to **increase dehydroepiandrosterone, anterior Pituitary hormones** like **Growth Hormone, Thyroid Stimulating Hormone (TSH), Prolactin** and **Melatonin** levels.

Meditation practices are reported to enhance the melatonin levels, the precursors of melatonin especially the **serotonin** and **noradrenalin**. Meditation increases melatonin concentration by slowing its hepatic metabolism or augmenting the synthesis in the pineal gland. **Diurnal melatonin levels were found to be significantly high in Vipassana meditators** (approximately 300 pg ml) than non-meditating controls (65 pg ml).

5) Meditation and Brain-Immune function:

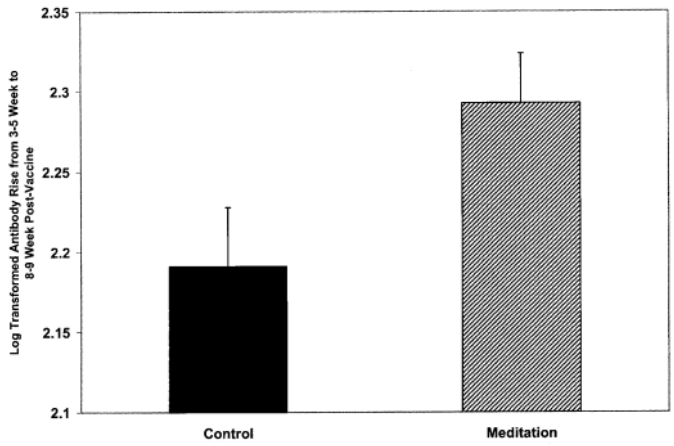


Fig: *Antibody rise from the 3- to 5-week to the 8- to 9-week blood draw in the Meditation and Control groups in response to Influenza vaccine*

Even a short program in mindfulness meditation produces demonstrable effects on brain and immune function. These findings suggest that meditation may change brain and immune function in positive ways.

The more your brain changes from meditation, the more you react to everyday life with that same sense of calm, compassion, and awareness.

References:

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