The Evidence for Meditation
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Our minds and bodies are inextricably linked. For example, in 2006 Dr Michael Gonzales of Duke University reported that people with depression are at an increased risk of heart attack and up to 40% of patients with cardiovascular disease suffer from depression.

Increasing concerns over the effectiveness of antidepressants have led clinicians to look for preventative, non-pharmacological options to treat illnesses such as depression. Meditation techniques – such as quietening the mind, understanding the self and exercising control – show promise as an alternative tool to regulate emotions, mood and stress.

Meditation is neither exclusively Buddhist nor even eastern. It has long been a part of monastic Christian practices, especially those of Jesuit founder Saint Ignatius de Loyola, while the practice of Sufi whirling, a form of physical meditation, is rooted in Islamic culture and traditions.

There are many varieties of meditation, including:

- concentration meditation, which involves focusing on an object;
- compassion meditation, which involves generating feelings of loving and kindness;
- insight meditation, which involves dispassionate observation of the self; and
- physical meditations like yoga.

These different types of meditation can have very different effects. Compassion meditation increases happiness and empathy, while concentration meditation improves attentional capacity and meditation-derived treatments such as mindfulness-based stress reduction (MBSR) are effective for psychological distress, depression and anxiety.

However, the various forms of meditation seem to have overlapping effects on attitudes, the body, the brain, and even the immune system. Our research team at the University of Sydney is investigating the effects of meditation on our bodies, our brains, and our ability to regulate our emotions.

Body
Half a century of research into biofeedback has demonstrated that conscious awareness of subtle bodily experiences can give us control over these experiences. For instance, if we give people information about their bodies that they are usually unaware of – such as blood pressure, heart rate, temperature and even brain waves – they are able to learn how to control these systems.
Meditation has traditionally been associated with Eastern mysticism, but science is beginning to show that cultivating a “heightened” state of consciousness can have a major impact on our brain, the way our bodies function and our levels of resilience. 

It seems plausible, therefore, that as meditation increases awareness of subtle sensations in the body, meditators become more able to deliberately control bodily responses that are usually not subject to voluntary control.

Meditation can influence the body in unexpected ways. Herbert Benson of Harvard University announced in a 1990 paper that experienced meditators could speed or slow their metabolism by more than 60%. In a 1982 study he observed that meditators could alter the temperature at their extremities by as much as 8°C. While such dramatic abilities to control the body have only been observed in very experienced meditators, there is no need to renounce the world and join a monastery to benefit from meditation.

Many benefits can be obtained by incorporating meditation into daily life. Even a little training in meditation can make people calmer, less stressed and more relaxed. As little as 20 minutes each day leads to physical changes such as reduced blood pressure, calmer breathing and even improvements in immune system function.

In 2009 Yi-Yuan Tang of the Dalian University of Technology reported changes in physiological reactions after a course of integrative mind–body training (IBMT), a technique adapted from traditional Chinese medicine that incorporates meditation and mindfulness practices. Tang reported that as little as 20 minutes of practice per day led to lower heart rate and sweat response, increased heart rate variability, and deeper and calmer breathing compared with a relaxation control group. These changes suggest that meditation can make people more emotionally balanced, and has important implications for cardiovascular health.

Meditation is also beginning to prove effective as a treatment for chronic and acute pain. An experiment conducted in 2011 by Fadel Zeidan of Wake Forest University showed that after 4 days of mindfulness meditation training, participants' experiences of unpleasantness and the intensity of induced pain were substantially reduced compared with readings taken at rest.

Neuroimaging techniques have revealed that reductions in pain intensity ratings are associated with increased activity in the anterior cingulate cortex and anterior insula, which are involved in the neural processing of unpleasant stimuli. Meditation does not seem to block sensations of pain like a conventional painkiller, but rather makes pain more bearable and allows people to go about their daily lives more easily.

**Mind, Brain and Beyond**

It has been suggested that meditation can increase positive mood, and also improve the function of the immune system. In 2003 Richard Davidson of the University of Wisconsin measured the brain activity of participants before and after an 8-week mindfulness meditation training program, and compared the EEG results with those allocated to a wait-list control (these participants were told that they were on a waiting list for treatment). Both groups were also vaccinated with influenza vaccine. Interestingly, meditation increased activity in left-sided frontal areas of the brain, which are associated with positive mood. Moreover, this increase in left-brain activity was linked to improvements in immune system activity, as measured by the response to the vaccine.

Another study conducted in 2010 by Yaxin Fan of Dalian University of Technology found that the immune improvements of meditation were dose-dependent, being greater after 4 weeks training than after 2 weeks. This suggests that the more you practise meditation, the greater your immune function is likely to be.

In 2009 Eileen Luders of the UCLA School of Medicine compared structural MRI scans of the brains of long-term meditators and non-meditators. Meditators had increased volumes of grey matter in the right orbito-frontal cortex and hippocampus regions of their brain which are responsible for regulating emotion.

Even a limited stint of meditation has the potential to change the structure of the brain. In 2010 Tang reported that 11 hours of IBMT training increases the integrity and efficiency of the white matter surrounding the anterior cingulate cortex, which is involved in self-regulation.

Similar changes were found in the hippocampus and cingulate cortex in 2011 by Britta Hözel of Massachusetts General Hospital for participants who completed an 8-week course in MBSR compared with those in a wait-list control group.

As we use various parts of our brains, they tend to develop – much like exercising a muscle. For instance, in 2003 and 2006 Eleanor Maguire of University College London reported that brain...
regions responsible for spatial representation are larger in London’s taxi drivers compared with control participants and bus drivers who follow constrained routes. Moreover, the size of the brain region is correlated with years of driving experience.

The brain changes observed in meditators provide the neural framework for improvements in their ability to regulate their emotions, mood and life stress.

Ageing
The cortex in the brain usually thins as we age — a type of atrophy related to dementia. In 2005, Sara Lazar of Massachusetts General Hospital used MRI to assess cortical thickness in experienced “insight” meditators and age-matched controls. Intriguingly, those who meditated around an hour per day for 6 years displayed increased cortical thickness in regions associated with attention, self-perception and sensory perception, including the prefrontal cortex and right anterior insula. Older meditators show decreased age-related decline in cortical thickness compared with non-meditators of the same age. These findings suggest that meditation may help protect against certain forms of dementia, although longitudinal studies following older meditators and non-meditators for several years would be needed to confirm this.

Meditation may increase longevity by protecting the brain and heart from the damaging effects of stress. In 2007, Glen Xiong from Duke University Medical Center suggested several possible mechanisms, such as decreased levels of stress-induced cortisol leading to neuroprotective effects and lowering oxidative stress, which could slow age-related neurodegeneration. In a related finding from 2005, Do-Hoon Kim of Hallym University found increased levels of serum nitrate, which is involved in the regulation of cardiac functions, and decreased lipid peroxidation (an indicator of oxidative stress) in meditators compared with controls. These changes may in turn lower the risk of cerebrovascular disease.

A 2008 study by Jeffrey Dusek of Harvard University reported that a group of participants with long-term experience in a variety of yoga and meditation practices exhibited marked changes in gene expression, as well as changes in cellular response to oxidative stress, which could help to prevent cellular damage caused by chronic psychological stress. Similar changes were observed in meditation-naïve participants given weekly 20-minute training sessions in relaxation and mindfulness techniques over as little as 8 weeks.

As our cells divide and reproduce, the protective telomeres that cap the ends of our chromosomes gradually shorten. This can eventually lead to damage, and is partially responsible for ageing at a cellular level. Critically, psychological stress is thought to speed up this degradation. In 2009, however, Elissa Epel of the University of California suggested that meditation might reduce the shortening of telomeres by decreasing psychological stress, and hence slow cellular ageing. If these findings are confirmed, meditation may help us live longer and healthier lives.

Emotional Stability
Meditation enhances positive emotions and mood, and appears to make people less vulnerable to the stresses and upsets of daily life. In 2006 Joanna Arch of UCLA studied the intensity of emotional response to negative pictures in meditation-naïve participants who had just undergone a 15-minute recorded mindfulness intervention involving focused breathing. Their responses were compared with participants who were instructed to listen to recorded instructions of worry or allowed to let their minds wander. Participants in the mindfulness group were better at regulating immediate responses to negative stimuli, reporting lower negative affect and a greater willingness to continue viewing highly negative pictures.

In a related finding, a 2007 neuroimaging study by Julie Brefczynski-Lewis of the University of Wisconsin, Madison, found that, in response to distracting sounds, experienced meditators had reduced activity in the amygdala — a region implicated in the response to threat. Another study conducted in 2000 by Michael Speca of the Alberta Cancer Board showed that mindfulness meditation improves mood and reduces stress symptoms in cancer outpatients compared with a wait-list control. These findings reflect greater emotional resilience among meditators as well as less psychological distress and anxiety.

Poor emotional resilience increases the likelihood and severity of a range of mental illnesses such as depression and anxiety disorders. Therefore, increasing resilience may help to reduce
Those who meditated around an hour per day for 6 years displayed increased cortical thickness in regions associated with attention, self-perception and sensory perception.

the mind and the body to calm emotional reactions. We are currently investigating the effects of meditation on brain and body function during emotional provocation, such as viewing disturbing photographic images.

Participants are being tested before and after an intensive 10-day course on Vipassana meditation, which was chosen for both its intensity – students meditate up to 12 hours per day for 10 consecutive days – and its standardised approach to teaching mindfulness at centres throughout the world. Brain activity is being measured by an EEG and heart activity by an ECG.

We want to better understand the effects of short, intensive periods of meditation on brain and body functions associated with the regulation of emotional responses. We are also examining genetic factors that may help determine what types of people benefit most from practicing meditation.

While our research is in its early stage, preliminary results suggest that an intensive course in meditation decreases stress and negative emotional experience, and increases satisfaction with life and mindfulness. Furthermore, the ratio of high to low frequency of heart rate variability increased. This is an indication of increased parasympathetic activity and weakening of the fight/flight response, and also reflects improved autonomic balance. These heart rate differences were greatest during a meditation task but remained noticeable even at a resting baseline, suggesting that the benefits may extend to everyday life.

Research into the longer-term effects of meditation on daily life can be complex. It is impossible to completely isolate the effects of diet change, changes in the sleep–wake schedule, the effects of prolonged sitting and a host of other factors from the effects of meditation itself. Finding a valid control group with which to compare meditators is also tricky. There is no handy placebo with which to rule out non-specific effects, as is available in pharmaceutical trials.

These problems, and others, have led to a healthy scepticism about research on meditation within much of the scientific community. Nevertheless, if we can demonstrate the efficacy of intensive meditation on emotion regulation, and characterise those who will benefit most, we will have established a significant role for meditation in improving and maintaining mental and physical health.

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