

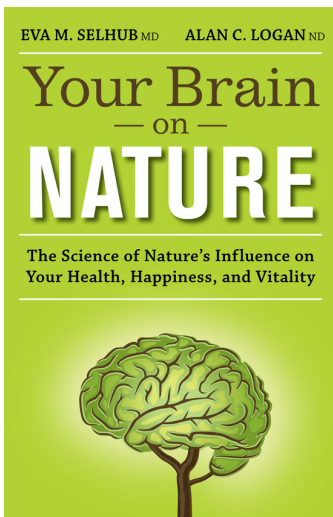
## Your Brain on Nature: Forest Bathing and Reduced Stress

*Studies show shinrin-yoku, also known as forest bathing or time spent in green spaces, can reduce the stress hormone cortisol and increase your immune defense system.*

January 8, 2013

<https://www.motherearthnews.com/natural-health/herbal-remedies/forest-bathing-ze0z1301zgar>

**By Eva Selhub and Alan Logan**



*“Your Brain on Nature” examines the fascinating effects that exposure to nature can have on the brain. Scientific studies have shown that natural environments can have remarkable benefits for human health. Natural environments are more likely to promote positive emotions; walking in nature has been associated with heightened physical and mental energy.*

**Cover Courtesy Wiley**

*It's no surprise that fresh air is good for your health, but that doesn't always make it easier to get a balance of healthy immersion in nature. Your Brain on Nature (Wiley, 2012) makes a case for better, healthier, greener thinking and improved mental health through exposure to greenspaces and provides tips for how to apply the science of optimal brain health to everyday life. In this excerpt, authors Eva Selhub and Alan Logan discuss research linking shinrin-yoku (Japanese "forest bathing" or "forest therapy") to increased cerebral blood flow, immune defense and improved mental health.*

*Buy this book in the MOTHER EARTH NEWS store: Your Brain on Nature (<https://www.motherearthnews.com/shopping/detail?itemnumber=6467>).*

## Shinrin-Yoku—Forest Bathing

*It is not so much for its beauty that the forest makes a claim upon men's hearts, as for that subtle something, that quality of air, that emanation from old trees, that so wonderfully changes and renews a weary spirit. —Robert Louis Stevenson*

Among the many reasons to preserve what is left of our ancient forests, the mental aspects stand tall. The notion that forests have a special place in the realm of public health, including an ability to refresh the weary, is not a new one. Medical doctors, including Franklin B. Hough, reported in early U.S. medical journals that forests have a “cheerful and tranquilizing influence which they exert upon the mind, more especially when worn down by

mental labor.” Individuals report that forests are the perfect landscape to cultivate what are called transcendent experiences—these are unforgettable moments of extreme happiness, of attunement to that outside the self, and moments that are ultimately perceived as very important to the individual.

In 1982, the Forest Agency of the Japanese government premiered its shinrin-yoku plan. In Japanese shinrin means forest, and yoku, although it has several meanings, refers here to a “bathing, showering or basking in.” More broadly, it is defined as “taking in, in all of our senses, the forest atmosphere.” The program was established to encourage the populace to get out into nature, to literally bathe the mind and body in greenspace, and take advantage of public owned forest networks as a means of promoting health. Some 64 percent of Japan is occupied by forest, so there is ample opportunity to escape the megacities that dot its landscape.

Undoubtedly, the Japanese have had a centuries-old appreciation of the therapeutic value of nature—including its old-growth forests; however, the term shinrin-yoku is far from ancient. It began really as a marketing term, coined by Mr. Tomohide Akiyama in 1982 during his brief stint as director of the Japanese Forestry Agency. The initial shinrin-yoku plan of 30 years ago was based solely on the ingrained perception that spending time in nature, particularly on lush Japanese forest trails, would do the mind and body good. That changed in 1990 when Dr. Yoshifumi Miyazaki of Chiba University was trailed by film crew from the Japanese Broadcasting Corporation (NHK) as he conducted a small study in the beautiful forests of Yakushima. It was a test of shinrin-yoku, and NHK wanted to be there. Yakushima was chosen because it is home to Japan’s most heralded forests. The area contains some of Japan’s most pristine forests, including those of select cedar trees that are over 1,000 years old. Miyazaki reported that a level of physical activity (40 minutes of walking) in the cedar forest equivalent to that done indoors in a laboratory was associated with improved mood and feelings of vigor. This in itself is hardly a revelation, but he backed up the subjective reports by the findings of lower levels of the stress hormone cortisol in subjects after forest walks compared with those who took laboratory walks. It was the first hint that a walk in a forest might not be the same as a walk in a different environmental setting.

Since then, university and government researchers have collaborated on detailed investigations, including projects to evaluate physiological markers while subjects spend time in the forest. The research team from Chiba University, Center for Environment, Health and Field Services, has collected psychological and physiological data on some 500 adults who have engaged in shinrin-yoku, and a separate group from Kyoto has published research involving another 500 adults. These studies have confirmed that spending time within a forest setting can reduce psychological stress, depressive symptoms, and hostility, while at the same time improving sleep and increasing both vigor and a feeling of liveliness. These subjective changes match up nicely with objective results reported in nearly a dozen studies involving 24 forests—lower levels of cortisol and lower blood pressure and pulse rate. In addition, studies showed increased heart rate variability, which is a good thing because it means the circulatory system can respond well to stress and can detect a dominance of the “calming” branch of the nervous system (the parasympathetic nervous system).

## Forest Therapy, Tree Density and Cerebral Blood Flow

Research has certainly shown that the emotions of pleasure and happiness are elevated with an increase in tree density within specific settings, even in urban settings. The bigger and denser the trees, the higher the scenic beauty scores—up to a point. If trees are too tightly packed—if a trail is too narrow or obscured—the scene becomes foreboding and fear will be increased.

Similarly, lining one’s walls with wood might be too much of a good thing. Japanese researchers have found the sweet spot for just the right amount of wood on the floor and walls in an interior environment—somewhere between 30 and 40 percent of surface area. This percentage has the highest rating of relaxation and is linked to

lower physiological stress markers (blood pressure and pulse rate). If you go all out and wood panel the entire room, like many a North American split-level ranch basement circa 1970, the stress markers can increase!

Adding to the strength of the research, in many of the studies, the objective measurements were also recorded in urban environments as a means of comparison. Here, the researchers controlled for physical activity, time of day, temperature, average hours of sunlight, and other factors. In other words, they weren't stacking the deck by recording the objective measurements in rainy and cold urban settings compared with sunny and warm forest environments. In one study, the researchers went so far as to bring an instrument capable of measuring brain activity out into the urban and forest settings. The time-resolved spectroscopy system (TRSS) device allows for a reading of oxygen use in the brain via the reflection of near-infrared light off red blood cells. The Japanese researchers found that 20 minutes of shinrin-yoku (compared with 20 minutes in an urban setting) altered cerebral blood flow in a manner that indicated a state of relaxation. More specifically, the total hemoglobin (as found in red blood cells) was decreased in the area of the prefrontal cortex while in the forest setting. Hemoglobin levels are jacked up in this area during anticipation of a threat (stress) and after periods of intense mental and physical work—complex equations, computer testing, video game playing, exercise to exhaustion. So essentially, a decrease in levels means the brain is taking a time-out while in the forest. Although sedatives are also known to reduce activity in this area of the brain, they can have detrimental influences in cognition. (We discuss in the next chapter how the restorative influences of nature actually increase cognitive abilities.)

Stress hormones can compromise immune defense; in particular, the activities of frontline defenders, such as antiviral natural killer cells, are suppressed by stress hormones. Since forest bathing can lower stress hormone production and elevate mood states, it's not surprising that it also influences markers of immune system strength. Qing Li and colleagues from the Nippon Medical School showed that forest bathing (either a day trip or a couple of hours daily over three days) can have a long-lasting influence on immune markers relative to city trips. Specifically, there were marked increases in the number of natural killer cells, increases in the functional activity of these antiviral cells, and increases in the amount of intracellular anticancer proteins. The changes were noted at a significant level for a full week after the trip. The improvements in immune functioning were associated with lower urinary stress hormones while in nature. None of this was observed during or after the comparison city trips. As mentioned, the reduction in stress is almost certainly at play in the improvement of immune defenses. However, the natural chemicals secreted by evergreen trees, collectively known as phytoncides, have also been associated with improvements in the activity of our frontline immune defenders. Li has measured the amount of phytoncides in the air during the studies and correlated the content to improvements in immune functioning.

This is an interesting finding in the context of the century-old reports on the success of the so-called forest cure in tuberculosis treatment. In the mid- to late 1800s, physicians Peter Detweiler and Hermann Brehmer set up sanatoriums in Germany's pine forests, as did Edward Trudeau in the Adirondack forests of New York. All reported the benefit of the forest air; indeed, contrary to expectations, the results seemed to be magnified when the forest air trapped moisture. There was speculation among the physicians of the time that pine trees secreted a healing balm into the air, and in yet another twist of the shinrin-yoku studies, the existence of an unseen airborne healer is being revealed.

Shinrin-yoku is alive and well today; the word has entered the Japanese lexicon. At present there are 44 locations approved as "forest therapy bases." These are sites that have been not only the subject of human research indicating benefits to stress physiology; a team of experts from the Japanese Forest Therapy Executive Committee ensures other criteria are met before designation, including accessibility, accommodation (if remote) cultural landmarks, historical sites, variety of food choices, and comfort stations. Chiba University's Miyazaki, who played a massive role in taking shinrin-yoku from a throwback marketing concept to credible preventive medicine intervention, continues to perform research and is now looking at the physiological effects of time spent in Tokyo's major urban parks.

# Using Plants to Reduce Pankiller Use

In the midst of performing his physiology studies, Ulrich published in 1984 a landmark study in the prestigious journal *Science*. He collected records from a single suburban Pennsylvania hospital from 1972 to 1981. He was very specific in what he examined—adults who had undergone identical surgery to remove the gallbladder (cholecystectomy) during this time frame—and the only major distinction among the patients was the room into which they were wheeled for recovery. Rooms on one side of the hospital had windows with a view to a mini-forest, while rooms on the other side offered a dramatically different vista in the form of bricks du rouge. The results were quite dramatic: those who had an outdoor view to trees had significantly shorter hospital stays and fewer postsurgical complaints. They also used less-potent analgesic medications (aspirin instead of narcotics). And to top it off, their nurses made fewer negative comments in their charts—and isn't it the dream of every patient to get out of a medical setting without the words "difficult patient" inscribed into a permanent medical record?

Ulrich, now retired from Texas A&M University and living in Sweden, has recently disclosed that his own experiences helped motivate him to examine the view from the hospital windows. Bedridden for extended periods as a teen with kidney disease, Ulrich recalls that his own view to evergreen was a factor that helped his emotional state. His original scientific observations have been replicated. For example, a recent study of cardio-pulmonary patients (published in *Clinical Rehabilitation* in 2011) showed that patients who had an unobstructed view of nature self-reported higher levels of health.

Since Ulrich's original observation, there have been additional studies confirming that the mere presence of flowering and foliage plants inside a hospital room can make a difference. Specifically, in those recovering an appendectomy and randomly assigned to a room with a dozen small potted plants, the use of pain medications was significantly lower than that of their counterparts in rooms with no potted plants; they also had lower blood pressure and heart rate, and rated their pain to be much lower. As well, those who had plants in their rooms had comparatively higher energy levels, more positive thoughts, and lower levels of anxiety.

Since a view of nature or a few potted plants can influence subjective and objective measures of stress, and maybe get us out of the hospital faster, it seems likely that nature can keep us out of the infirmary to begin with. The first indication that this might be the case was in the reporting of architect Ernest Moore in 1981. In examining the annual sick records of the State Prison of Southern Michigan, he noticed there was a glaring difference in health-care utilization based on cell location. Specifically, those inmates housed in the cells facing outside to a view of green farmlands and forests had far fewer visits to the medical division than did those inmates housed in the inner half, with a view of an internal concrete yard. In addition:

- Norwegian research shows that having a plant at or within view of an office workstation significantly decreases the risk of sick leave. A 2010 study from the University of Technology, Sydney, Australia, reported that levels of anger, anxiety, depressive thoughts, and fatigue all reduced over a three-month period, and not just by a little bit—these parameters were reduced by about 40 percent, while reported stress was down by 50 percent. On the other hand, those without the stress buffer of a visible plant indicated that stress levels rose over 20 percent during the study.
  - Installing plants within a radiology department of a hospital reduced short-term sick leave by 60 percent.
  - Research published in 2008 in the *Journal of the Japanese Society for Horticultural Science* showed that greening select high school classrooms with potted plants for a four-month trial period significantly reduced visits to the infirmary compared with age-matched students attending classes without the visible plants.
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