

We now know that the brain controls the formation of bone

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The brain acts as a profound regulatory centre, controlling myriad processes throughout the body in ways we are only just beginning to understand. In new findings, Australian scientists have shown surprising connections between the brain and regulation of bone mass.

One of the key functions of our skeletons is to provide mechanical support. In order to fulfil this role, bone tissue is modified throughout our lives, in response to changing activity levels and body weight. Bone mass increases as we gain weight and decreases as we lose it.

The new findings show that bone formation, far from being a straightforward mechanical process dependent on body weight, is delicately orchestrated by the brain, which sends and receives signals through the body's neural and hormone systems.

It is now clear that the neural network which controls appetite and energy also alters bone density. When we are starving, our brains don't allow us to waste energy by reproducing, making fat or creating new bone. When we are eating too much, on the other hand, our brains make it easier to reproduce, store fat and create bone.

Dr Paul Baldock, a neuroscientist from Sydney's Garvan Institute of Medical Research, has demonstrated in mice that the neurotransmitter Neuropeptide Y (NPY) directly controls osteoblasts, the cells that make bone. His findings are now published in the international online journal *Public Library of Science ONE (PLoS ONE)*.

"It has always been thought that changes in bone mass are purely mechanical - you get heavier and your bones get denser to support the increased load," said Baldock.

"While that's true to some extent, our findings show a sophisticated central surveillance system at work. It's as if the brain, as boss, sends out a global memo saying 'make more bone'."

"Bone-making cells at local level appear to have the ability to fine-tune this directive, like office workers saying 'we're not going to waste time putting on bone here when it's needed more over there'."

"So what happens in practice is that places exposed to more load put on more bone, while those exposed to less load put on less bone."

All the intricate central processing takes place in the hypothalamus, a small yet complex region of the brain that links the nervous and hormone systems.

According to Baldock, the NPY system in the brain evolved to allow survival of humans during very lean times as well as plenty. “In evolutionary terms, people are kept alive so that they can reproduce, and body systems are all integrated to preserve that function.”

“I have no doubt that osteoporosis treatments of the future will find a safe way to block NPY receptors on osteoblasts,” said Baldock.

“Obviously, the development of such treatments would have to take account of all the processes affected by the NPY system – including appetite and mood. You’d need something that increased bone mass without also making people fat, skinny, sad or angry at the same time.”

As a first step, Baldock is showing the orthopaedic relevance of his findings at the Children’s hospital at Westmead, where he is collaborating with an orthopaedic surgeon, Associate Professor David Little.

ABOUT GARVAN

The Garvan Institute of Medical Research was founded in 1963. Initially a research department of St Vincent's Hospital in Sydney, it is now one of Australia's largest medical research institutions with nearly 500 scientists, students and support staff. Garvan’s main research programs are: Cancer, Diabetes & Obesity, Immunology and Inflammation, Osteoporosis and Bone Biology, and Neuroscience. The Garvan’s mission is to make significant contributions to medical science that will change the directions of science and medicine and have major impacts on human health. The outcome of Garvan’s discoveries is the development of better methods of diagnosis, treatment, and ultimately, prevention of disease.

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