

Australasia, and the human introduction of the dingo (*Canis lupus dingo*) to Australia several thousand years ago reduced numbers still further, leaving an isolated thylacine population clinging on only in Tasmania. European colonists in the nineteenth century saw the predators as a threat to their sheep, and paid a bounty of £1 per carcass. Thylacines were on the cusp of extinction in the wild when the rewards were ended in 1909, leading zoos to pay handsomely for the few remaining individuals.

Geneticists had previously sequenced the species' mitochondrial genome — a short stretch of DNA that is maternally inherited — using hairs plucked from a thylacine stored at the Smithsonian Institution in Washington DC². In the latest study, a team led by developmental geneticist Andrew Pask of the University of Melbourne obtained the much longer nuclear genome by sampling tissue from a one-month-old thylacine that had been found in its mother's pouch in 1909 and was preserved in alcohol.

Compared to the mitochondrial genome, the nuclear genome holds information about many more ancestors. The team saw a drop in the thylacine's genetic diversity, suggesting that population numbers began dwindling some 70,000–120,000 years ago, well before humans reached Australia. Similar patterns have been found in the genome of the Tasmanian devil (*Sarcophilus harrisii*)³. Feigin suspects that a cooling climate shrank the habitats of both species, making them more vulnerable to humans.

Thylacines are not closely related to the dog family, known as canids — the groups' common ancestor lived around 160 million years ago — but their heads are remarkably similar in shape. This hints that the groups might have adapted similarly to facilitate their predatory lifestyles. To test for such convergent evolution, Feigin and Pask's team identified 81 protein-coding genes in which both canids and thylacines had acquired comparable DNA changes, including some with roles in skull development. But none of the relevant genes seemed to evolve under natural selection in either lineage.

Instead, the team proposes that DNA that does not affect protein sequences, but influences how they are expressed, underlies the long snouts and other traits shared by both groups.

That's a “reasonable inference”, says Sean Carroll, an evolutionary developmental biologist at the University of Wisconsin–Madison; new physical traits tend to arise when the expression of developmental pathways shared across animals shifts. ■

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UIG WAGETY

Results from a large trial suggest acupuncture might ease pain in women with breast cancer.

PAIN MANAGEMENT

Acupuncture study reignites debate

Large trial suggests controversial technique could work.

BY JO MARCHANT

One of the largest-ever clinical trials into whether acupuncture can relieve pain in people with cancer has reignited a debate over the role of this contested technique in cancer care.

Oncologists who conducted a trial of real and sham acupuncture in 226 women at 11 cancer centres across the United States say their results — presented on 7 December at the San Antonio Breast Cancer Symposium in Texas — conclude that the treatment significantly reduces pain in women receiving hormone therapy for breast cancer. They suggest it could help patients stick to life-saving cancer treatments, potentially improving survival rates. But sceptics say it is almost impossible to conduct completely rigorous double-blinded trials of acupuncture.

Interest in acupuncture has grown because of concerns over the use of opioid-based drugs, which can have nasty side effects and are extremely addictive. Many cancer centres in the United States therefore offer complementary therapies for pain relief. Almost 90% of US National Cancer Institute-designated cancer centres suggest that patients try acupuncture, and just over 70% offer it as a treatment for side effects¹. That horrifies sceptics such as Steven Novella, a neurologist at Yale University School of Medicine. Acupuncture has no scientific basis, he

says; recommending it is “telling patients that magic works”.

But Dawn Hershman, an oncologist at Columbia University Medical Centre in New York City, decided to investigate whether acupuncture could help to reduce the pain caused by aromatase inhibitors, one of the most commonly used treatments for breast cancer. These drugs lower oestrogen levels and, when taken over five to ten years, reduce the risk that the cancer will recur. But they cause side effects, especially arthritis-like pain, which can cause up to half of women to take the medication irregularly, or to stop taking it altogether.

MEANINGFUL RELIEF

After a small trial showed positive results², Hershman and her colleagues conducted a larger one. The 226 women were placed in one of three groups: one that received acupuncture; another that got a sham treatment in which needles were inserted at non-acupuncture points; and a third that received no treatment. The researchers trained the acupuncturists to deliver consistent treatments³. The women were asked to record their pain.

After a six-week course of treatment, ‘worst pain’ in the true-acupuncture group was about one point lower on a scale of zero to ten than in either the sham or no-treatment groups. This is a statistically significant ▶

▶ effect, and larger than is seen with alternatives such as duloxetine, an antidepressant used to help reduce pain in people with cancer⁴. Meanwhile, the proportion of participants whose pain improved by at least two points (which Hershman describes as a “clinically meaningful” change) almost doubled, from around 30% in both control groups to 58% in the true-acupuncture group. Unlike with duloxetine, the benefits persisted after the acupuncture course had finished. Hershman concludes that acupuncture is a “reasonable alternative” to prescription medications such as duloxetine or opiates.

Rollin Gallagher, director of pain-policy research at the University of Pennsylvania in Philadelphia, and editor-in-chief of the journal *Pain Medicine*, welcomes the trial. “These are careful methodologists,” he says. “There is moderate to good evidence in clinical trials for acupuncture now, and this is another contribution.”

PLACEBO EFFECT?

But sceptics have criticized the research. Regardless of how rigorous the trial was, the acupuncturists knew whether they were delivering real or sham treatment, says Edzard Ernst, emeritus professor of complementary medicine at the University of Exeter, UK. This could have influenced how the recipients responded, he says. “I fear that this is yet another trial suggesting that acupuncture is a ‘theatrical placebo.’”

But Jun Mao, chief of integrative medicine at the Memorial Sloan Kettering Cancer Centre in New York City, says that acupuncture trials such as Hershman’s are better blinded than studies of approaches such as palliative care, cognitive behavioural therapy or exercise, in which participants inevitably know what treatment they are receiving. Sceptics “accept trial results from those fields readily, but they make a special case against acupuncture”, he says. “It’s not fair to use that single argument to shut down the whole field.”

For Hershman, the sceptics’ concerns risk losing sight of what’s best for patients. “To say that something that is pharmacologic is better, when it causes horrible toxicities, is also problematic,” she says. With acupuncture, “we tried to do the most rigorous study we could. At the end of the day, if it keeps somebody on their medication or improves the quality of their life, then it’s worth it.” ■

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SHANNON STAPLETON/REUTERS

Graduate students in New York City rally against the proposed tax bill in late November.

POLICY

Proposed US student tax hike spurs anger

Worries over the cost of a university education spark protests across the country.

BY HELEN SHEN

Jessica Frick was the first in her family to graduate from university, and she hopes to be the first to obtain her PhD. But a looming decision on US tax legislation could drastically increase taxes on university students such as Frick, who worries that she might not be able to afford to finish her chemistry doctorate at Princeton University in New Jersey.

Many US universities waive tuition fees for students who conduct research or teach. But a provision in a tax bill passed by the US House of Representatives in mid-November would add that tuition to students’ taxable income. The vote prompted demonstrations at more than 60 US universities on 29 November. Eight graduate students were arrested on 5 December while protesting outside the Capitol Hill office of House speaker Paul Ryan.

Tax legislation passed by the US Senate on 2 December does not include the provision. But students, universities and advocacy groups are hoping to beat back the provision in the House bill as lawmakers work to reconcile the two and prepare to vote on the revised legislation.

Institutions including Johns Hopkins University in Baltimore, Maryland, Tufts University in Medford, Massachusetts, the University of California system and Ohio State University

in Columbus have sent letters to, or met with, members of Congress to keep tuition waivers tax-free. The Association of American Universities (AAU) in Washington DC, which represents 60 US universities, has also pushed back in meetings and letters. “This is not in America’s national interest,” according to a missive that the AAU co-signed with 45 other higher-education associations.

PAYING FOR IT

Many worry about what will happen if the tuition tax survives. “I would have to get a second job,” says Frick, who spends up to 60 hours a week in the lab. “It would be impossible.” Her roughly US\$30,000 annual stipend barely covers her living expenses and medical costs to treat a serious jaw condition.

Janice and Sean Hudson — geography PhD students at the University of Delaware in Newark — nearly exhaust their stipends on living expenses and supporting their three-year-old son. If the tuition tax passes, they may have to take out a loan; in the worst-case scenario, one of them might have to drop out.

The systemic effects of the tax would ripple through science, technology, engineering and mathematics (STEM) in the United States; STEM students receive 60% of US graduate tuition waivers, according to the American