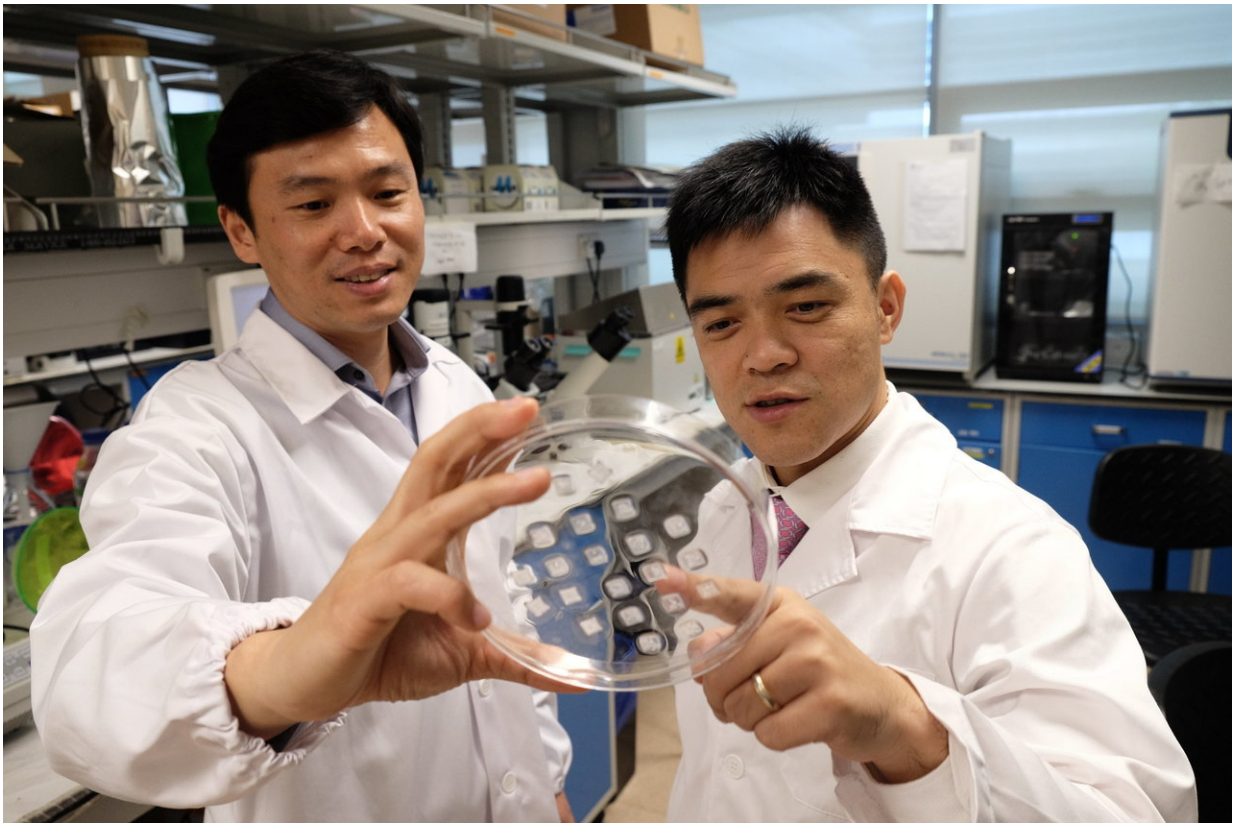


New patch aims to turn energy-storing fats into energy-burning fats

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Prof Chen Peng (left) holding the new microneedle fat burning patch with Asst Prof Xu Chenjie . Credit: Nanyang Technological University

A micro-needle patch delivers drugs that are known to turn energy-storing white fat into energy-burning brown fat. This innovative

approach developed by scientists from Nanyang Technological University, Singapore (NTU Singapore), reduced weight gain in mice on a high-fat diet and their fat mass by more than 30 percent over four weeks.

The new type of skin patch contains hundreds of micro-needles, each thinner than a human hair, which are loaded with the [drug](#) Beta-3 adrenergic receptor agonist or another drug called thyroid hormone T3 triiodothyronine.

When the patch is pressed into the skin for about two minutes, these micro-needles become embedded in the skin and detach from the patch, which can then be removed.

As the needles degrade, the drug molecules then slowly diffuse to the energy-storing white fat underneath the skin layer, turning it into energy-burning brown fats.

Brown fats are found in babies, and they help to keep the baby warm by burning energy. As humans grow older, the amount of brown fats lessens and is replaced with visceral white fats.

Published in the journal *Small Methods* recently by NTU Professor Chen Peng and Assistant Professor Xu Chenjie, this approach could address the worldwide obesity problem without resorting to surgical operations or oral medication.

"With the embedded microneedles in the skin of the mice, the surrounding fats started browning in five days, which helped to increase the energy expenditure of the mice, leading to a reduction in body fat gain," said Asst Prof Xu, who focuses on research in drug delivery systems.

"The amount of drugs we used in the patch is much less than those used in oral medication or an injected dose. This lowers the drug ingredient costs while our slow-release design minimises its side effects," said Asst Prof Xu.

Obesity which results from an excessive accumulation of fat is a major health risk factor for various diseases, including heart disease, stroke and type-2 diabetes. The World Health Organisation estimates that 1.9 billion adults in the world are overweight in 2016 with 650 million of them being obese.

"What we aim to develop is a painless patch that everyone could use easily, is unobtrusive and yet affordable," said Prof Chen, a biotechnology expert who researches on obesity. "Most importantly, our solution aims to use a person's own body fats to burn more energy, which is a natural process in babies."

Under the two scientists' guidance at NTU's School of Chemical and Biomedical Engineering, research fellow Dr. Aung Than conducted experiments which showed that the patch could suppress weight gain in mice that were fed a high-fat diet and reduce their [fat mass](#) by over 30 percent, over a period of four weeks.

The treated mice also had significantly lower blood cholesterol and fatty acids levels compared to the untreated mice.

Being able to deliver the drug directly to the site of action is a major reason why it is less likely to have side effects than orally delivered medication.

The team estimates that their prototype [patch](#) had a material cost of about S\$5 (US\$3.50) to make, which contains beta-3 adrenergic receptor agonist combined with Hyaluronic acid, a substance naturally found in

the human body and commonly used in products like skin moisturisers.

Beta-3 adrenergic receptor agonist is a drug approved by the Federal Drug Administration of the United States and is used to treat overactive bladders, while T3 triiodothyronine is a thyroid hormone commonly used for medication for an underactive thyroid gland.

Both have been shown in other research studies to be able to turn white fats brown, but their use in reducing [weight gain](#) is hampered by potentially serious side-effects and drug accumulation in non-targeted tissues if conventional drug delivery routes were used, such as through oral intake.

NTU's Lee Kong Chian School of Medicine Associate Professor Melvin Leow, who was not affiliated with this study, said it is exciting to be able to tackle obesity via the browning of white fat, and the results were promising.

"These data should encourage Phase I Clinical studies in humans to translate these basic science findings to the bedside, with the hope that these microneedle patches may be developed into an established cost-effective modality for the prevention or treatment of obesity in the near future," added Assoc Prof Leow, an endocrinologist.

Since the publication of the paper, the team has received keen interest from biotechnology companies and is looking to partner clinician scientists to further their research.

More information: Aung Than et al. Transdermal Delivery of Anti-Obesity Compounds to Subcutaneous Adipose Tissue with Polymeric Microneedle Patches, *Small Methods* (2017). [DOI: 10.1002/smt.201700269](https://doi.org/10.1002/smt.201700269)

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