Medical Xpress

Weight loss through slimming found to significantly alter microbiome and brain activity

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Worldwide, more than one billion people are obese. Obesity is a risk factor for cardiovascular disease, diabetes, and some cancers. But permanently losing weight isn't easy: complex interactions between body systems such as gut physiology, hormones, and the brain are known to work against it. One method for weight loss is intermittent energy

restriction (IER), where days of relative fasting alternate with days of eating normally.

"Here we show that an IER diet changes the human brain-gut-microbiome axis. The observed changes in the gut microbiome and in the activity in addition-related brain regions during and after weight loss are highly dynamic and coupled over time," said last author Dr. Qiang Zeng, a researcher at the Health Management Institute of the PLA General Hospital in Beijing. The study has been published in *Frontiers in Cellular and Infection Microbiology*.

The fast track to weight loss

The authors used metagenomics on stool samples, blood measurements, and functional magnetic resonance imaging (fMRI) to study changes in the composition of the gut microbiome, physiological parameters and serum composition, and brain activity in 25 obese Chinese women and men on an IER diet. Participants were on average 27 years old, with a BMI between 28 and 45.

"A healthy, balanced gut microbiome is critical for energy homeostasis and maintaining normal weight. In contrast, an abnormal gut microbiome can change our eating behavior by affecting certain brain area involved in addiction," explained co-author Dr. Yongli Li from the Department of Health Management of Henan Provincial People's Hospital in Henan, China.

First, the participants underwent a 'high-controlled fasting phase' of 32 days where they received personalized meals designed by a dietician, with a caloric value decreasing stepwise to one-quarter of their basic energy intake. They then spent 30 days in a 'low-controlled fasting phase,' where they were given a list of recommended foods: participants who adhered perfectly to this diet would receive 500 calories per day for

women and 600 calories per day for men.

Synchronous changes in brain activity and gut microbiome

By the end of the study, their body weight had decreased by an average of 7.6kg, or 7.8%. As expected, they had undergone reductions in body fat and waist circumference.

Likewise, their blood pressure and serum levels of fasting plasma glucose, total cholesterol, HDL and LDL had decreased, and the activity of key liver enzymes. These suggest that IER helps to reduce obesity-related comorbidities like hypertension, hyperlipidemia, and liver dysfunction.

The authors observed decreases after IER in the activity of brain regions implicated in the regulation of appetite and addiction. Within the gut microbiome, the abundance of the bacteria Faecalibacterium prausnitzii, Parabacteroides distasonis, and Bacterokles uniformis increased sharply, while that of Escherichia coli fell.

Further analyses showed that the abundance of E. coli, Coprococcus comes, and Eubacterium hallii bacteria were negatively associated with the activity of the brain's left orbital inferior frontal gyrus—known to play a key role in executive function, including our will to lose weight. In contrast, the abundance of the bacteria P. distasonis and Flavonifractor plautii were positively correlated with the activity brain regions associated with attention, motor inhibition, emotion, and learning.

Weighing the evidence

These results suggest that changes in the brain and microbiome during

and after weight loss are linked—either because they cause each other, or because an unknown other factor causes both. Because the study is correlational, it can't resolve the direction of the underlying causality.

"The gut microbiome is thought to communicate with the brain in a complex, two-directional way. The microbiome produces neurotransmitters and neurotoxins which access the brain through nerves and the blood circulation. In return the brain controls eating behavior, while nutrients from our diet change the composition of the gut microbiome," said co-author Dr. Xiaoning Wang from the Institute of Geriatrics of the PLA General Hospital.

Co-author Dr. Liming Wang, likewise from the Health Management Institute in Beijing, said, "The next question to be answered is the precise mechanism by which the gut microbiome and the brain communicate in obese people, including during weight loss. What specific gut microbiome and brain regions are critical for successful weight loss and maintaining a healthy weight?"

More information: Dynamical alterations of brain function and gut microbiome in weight loss, *Frontiers in Cellular and Infection Microbiology* (2023). DOI: 10.3389/fcimb.2023.1269548. www.frontiersin.org/articles/1 … mb.2023.1269548/full

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