

# Gut microbiome and Obesity: A new attempt on obesity treatment

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**ABSTRACT.** *Microbiome plays a crucial role in balancing our body. Obesity is a prevailing disease among the whole world without any sufficient drugs to deal with the increasing risks of later syndromes, which is why our group wants to pay more attention on it. Obesity is a severe disease which has been ignored by the public, while microbiome is known to benefit our body. We should give priority to know how these two are actually the case, what the mechanisms of them are and what the contribution of them is. On the basis of previous researches on treating obesity with microbiome such as after weight-loss intervention, our group also came up with new ideas of treatment which aimed at digestion and plantation in the area of pharmacology, immunology and psychology. However, certain studies must be carried out to test whether these innovations are workable.*

**KEYWORDS:** *Microbiome; Obesity; Mechanism; Treatment*

## 1. Introduction

### 1.1 Microbiome

Microbiome is the community of all the microbes that live on and inside of human body, most of them live in the gut, some in the intestine and they are much more than our human cells. Microbiome plays a crucial role in our body, such as help digest, regulate immune system, protect against other bacteria and disease,

produce vitamins, and maintain tissue homeostasis. And the correct proportion of the main bacteria, firmicutes, bacteroidetes, actinobacteria, proteobacteria and archaea, is also important for our health.

## 1.2 Obesity

Obesity is a common but complex disease which is caused by excessive fat accumulation in a prevalence of the whole world. The worldwide prevalence of obesity (Body mass index, BMI  $\geq 30$  kg m<sup>-2</sup>) increased from 3.2% to 10.8% in men and from 6.4% to 14.9% in women over the last 4 decades. [1] And the prevalence of obesity was 42.4% in 2017-2018 and severe one is 9.2% in the same time period. [2]

The harmfulness of obesity also appears in the later syndromes, among them are ischemic heart disease, stroke, type 2 diabetes mellitus, hypertension, hyperlipidemia, and several cancers.[3] People who have obesity have been associated with increased risk of these diseases.

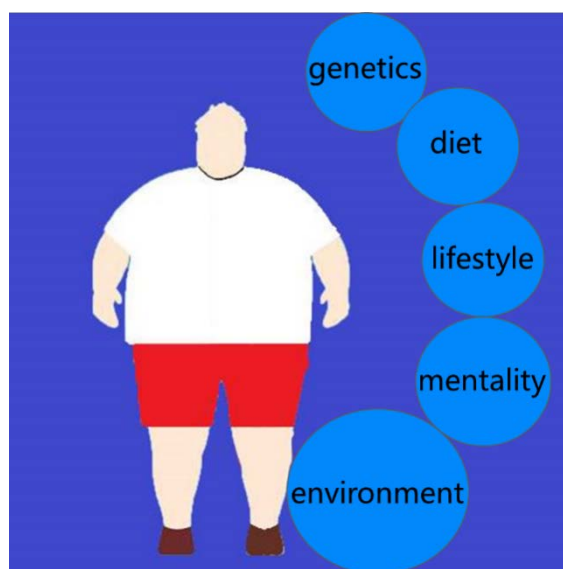
There are amount of factors lead to obesity, namely genetics, excessive caloric intake, sedentary lifestyle, socioeconomic status, poor sleep quality, parental weight, the environment and microbiome. [4]

However, the treatment focused on lifestyle to decrease the energy intake and increase the physical activity is unsustainable and unsuccessful. [5] First of all, the bacterial surgery is not suitable for every obese live and then the patients should keep exercise and diet to maintain long-term weight loss. [6,7] Secondly, the anti-obesity drug have the concern of safety and efficiency, or even been moved due to the side effect of psychology and physics, including depression, anxiety, cardiovascular events and stroke[8,9]

## 2. Mechanism

In this essay I am going to talk about three things: the cause of obesity, the role of microbiota and the contribution between microbiota and obesity and the detailed mechanism of these three.

First comes to the causes of obesity, there are several reason causing it. The significant factor is genetics. When the parental weight is high, their kids are also prone to obesity. This is because they might have genes which make them easy to be fat, and these genes are likely to pass on to the next generation. The diet ones have is as effective as gene. As when you have more lipids in your diet than others, you will be more vulnerable than others to reach obesity. The next remarkable factor is the amount of exercise. If you have a sedentary lifestyle and are lack of exercise, your body will not be able to consume the entire intake of energy. So the excessive calories will be store in your body as the form of sugar or fat, and with time it generates, you will get obesity. Another ignored factor is the mental state. Because when one is depressed, he or she will tend to eat more to get out of depression, while this will make him or her more into depression, so this is a vicious



cycle.

Next part is the role of microbiota. The most important one is that they help use to digest. There are many kinds of food which contain polysaccharides that our human are not able to digest. This is due to that we are not able to produce the enzyme to decompose them, while some bacteria can. So they cut them down into simple sugar, then our intestine can absorb them. The most significant thing that microbiota do to help our immune system is to help us developing intestinal epithelium, and then pathogen cannot penetrate the epithelium easily. When the

microbiota is staying on the intestine, they are keeping trying to get inside our body. Thus the epithelium has plenty of chances to enhance itself. Another benefit by staying on the intestine is that they are able to keep the foreign pathogen away from us. These small microbes need space and food for surviving, to avoid the competition with others, they will produce several chemicals to suppress or even kill the pathogen. Also, microbiota is able to supply us with nutrients. There are many vitamins that are unable to produce by our body and are unavailable from our food, with the food we provided for them, they can synthesis the vitamins for us in turn.

Then it comes to the contribution of the above two. As I have mentioned above when we have too much fat from the diet, we get obesity with a doubt. But with the help of microbiota, we are able to get rid of them, they can endocytose the lipid and transfer it into a non-lipid and release it to us or transfer it into a polysaccharide which we cannot absorb and they will go with the excreta. Also as they live, they also need calories for their living hence the excessive energy will be gone. And microbiota can even affect our mental state. In a scientific research, there are two kinds of mice, specific pathogen-free (SPF) BALB/c mice or germ-free BALB/c mice, it is found out that probiotics increase the exploratory behavior and hippocampal expression of BDNF. [10] And microbiota can also change our immune state. As it kills the pathogen so our immune system is not needed, hence less energy is needed. So there is less demand for energy, and we are less tending to eat much.

### **3. Treatment**

#### **3.1 Probiotics changes gut microbiota composition and improves adiposity measures.**

We can use probiotics to change gut microbiota composition in order to enhance adiposity measures because probiotics have the ability to modify gut microbiota, increase adhesion to intestinal mucosal surface, improve gut epithelial barrier, produce anti-microorganism substances and modulate immune system [11]. Researchers have performed several studies that investigated the use of probiotics as anti-obesity treatments on mice and humans and many of them have succeeded.

### **3.2 Prebiotics increases Bifidobacterium and reduces adiposity.**

Prebiotics can increase the amount of bifidobacterium and reduce adiposity. Prebiotics are indigestible oligosaccharides that promote the growth of beneficial probiotics like Bifidobacterium species. Prebiotics was found to increase the abundance of Bifidobacterium that may in part explain the increased satiety and decreased appetite in the obese subjects.

### **3.3 Engineered microbes reduce food intake and lower body weight.[11]**

Engineered probiotics can directly delivered by-product or substances that cause weight loss [11], thus fixing the problem of obesity.

### **3.4 Cross-talk between Akkermansia muciniphila and intestinal epithelium controls diet-induced obesity.**

Researchers isolated Akkermansia muciniphila in order to study microbial composition and the mechanisms of interaction with the host that influence gut barrier function during obesity. It turned out that prebiotic feeding normalized A. muciniphila abundance, which correlated with an improved metabolic profile. A. muciniphila treatment can also reverse high-fat diet-induced metabolic disorders and increase the intestinal levels of endocannabinoids that control inflammation, the gut barrier, and gut peptide secretion. These facts may be the cause of A.muciniphila's control on diet-induced obesity. These results provide a rationale for the development of a treatment that uses this human mucus colonizer for the prevention or treatment of obesity and its associated metabolic disorders.[12]

### **3.5 After-weight-loss intervention**

The research group identified obesity-associated gut microbial species linked to changes in circulating metabolites. The abundance of Bacteroides thetaiotaomicron, a glutamate-fermenting commensal, was markedly decreased in obese individuals and was inversely correlated with serum glutamate concentration. Consistently, gavage with B. thetaiotaomicron reduced plasma glutamate concentration and alleviated diet-induced body-weight gain and adiposity in mice. Furthermore,

weight-loss intervention by bariatric surgery partially reversed obesity-associated microbial and metabolic alterations in obese individuals, including the decreased abundance of *B. thetaiotaomicron* and the elevated serum glutamate concentration. The findings identify previously unknown links between intestinal microbiota alterations, circulating amino acids and obesity, suggesting that it may be possible to intervene in obesity by targeting the gut microbiota.[13]

#### **4. Discussion**

Till now, we have come up with several innovations.

##### **4.1 Microbiome may help with our digestion.**

We think it may be possible to put microbiome in our gut to digest the food for us and produce things that will not cause obesity. For instance, instead of fat and sugar, they can make productions like cellulose and so on.

##### **4.2 Microbiome can affect pharmacology and immunology.**

Some drugs for obesity have severe adverse reactions like stomach ache, vomit, loss of appetite. In terms of microbiome's effect on pharmacology and immunology, we can develop better medicine as treatment of obesity.

##### **4.3 Microbiome can affect mental health.**

Multiple mechanisms are involved by which the microbiota influences the brain and host behavior. [14] Certain signals will be sent to the brain so that the satiety will be decreased and the mood will be modulated. We can use microbiome to change mental state, improve hormone production and energy intake and induce the patients to exercise more.

#### 4.4 Plant some beneficial microbiome after certain surgeries.

We can do the plantation after surgeries like washing away the waste in the gut. But we have to come up with methods to eliminate adverse reactions during the surgeon.

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