Modifying the microbiome:A gateway to treat Type 2 diabetes?

By Sarah Trottier & Logan Townsend

Type 2 diabetes (T2D) is a fast-growing epidemic, and although lifestyle and genetics are common contributors to its causality, recent research now shows that the bacteria living inside of our digestive tract (i.e. the gut microbiome) is another important factor. Indeed, the composition and diversity of the microbiome differs between obese and lean individuals with T2D (1), but even between diabetics and non-diabetics regardless of obesity (2). This has lead researchers to pursue a deeper understanding of the pathophysiological events linking the microbiome to host metabolism, in hopes of uncovering new potential therapeutic options.

For example, one study involved transplanting gut bacteria from typical mice into germ-free mice (mice without any gut bacteria) and observed a drastic increase in body weight within only 10 days (3). Part of the reason for this is that some microbiome compositions fa- cilitate greater caloric extraction from the diet, thus lead- ing to an increase in fat storage (4). This is exemplified by germ-free mice, which are resistant to obesity and T2D, even when fed a high-fat "western" diet (4).

It is well-known that exercise can prevent and treat T2D; interestingly, data from rodents shows a ro- bust effect of exercise on the microbiome, which may be contributing to the positive effects of exercise. Willem Peppler, a doctoral student at the University of Guelph, says there are specific bacterial strains, namely Bifidobacterium and Akkermansia muciniphila, that improve intestinal health, and that these strains are increased with exercise. But Peppler also notes that it is difficult to determine if there is a consistent effect of physical fitness on the microbiome in every individual. While there are a lot of data assessing the effect of exercise training on the microbiome in rodents, there are virtually no data in humans. Given that there are differences in the microbiome between individuals based on diet, geographical location, and other factors, it would be beneficial to determine whether the effects of exercise training observed in rodent models apply to humans as well.

Even if we can affect the human microbiome in positive ways through exercise, the microbiome tends to to remain relatively stable within a few years after birth, and seems to only temporarily respond to select stimuli (like exercise, diet, and antibiotics). Promisingly, metabolic benefits were observed when gut bacteria were transplanted from lean donors into recipients with metabolic syndrome (2). But while the transplantation of microbiomes may work in humans, this procedure remains controversial... and icky. These results raise the intriguing question of whether it is possible to engineer an 'ideal' microbiome that would be capable of harvesting sufficient energy and nutrients from the diet, but make one resistant to obesity and T2D. For example, we could reduce the quantity of Erysipelotrichaceae and Turicibacteraceae, two bacterial families associated with obesity and gut inflammation. Or it may be as simple as engineering greater microbial diversity, as this is decreased in obese and diabetic individuals. Despite probiotics and prebiotics being commercially available for decades, research into the relationship between host and microbiome is relatively young, but there are already extremely promising results. Who knows, one day we may all be popping pills full of gut germs to try and stay healthy!☐

References

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Sarah is currently completing her MSc degree at the University of Guelph. She previously received a bachelor's degree in Health Promotion at Laurentian University. Her interest in exercise physiology and nutrition has inspired her current research focussing on the additive effects of dairy protein and exercise training on body weight management.

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