

# How are aging and gut bacteria related?

Diversity is good!

Let's keep our human healthy!

Let's welcome more types of bacteria!

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## Abstract

We know that bacteria can be harmful and can cause a lot of diseases. But did you know that not all bacteria are bad? In fact, there are trillions of bacteria inside us that help us to live! These bacteria make up the gut microbiome. We wanted to understand the relationship between our gut bacteria and how we age. We found

that as we get older, the different types of bacteria in our gut microbiome change. We also discovered that diseases and medication can affect this change. Knowing more about how our gut bacteria work can help us live healthier lives!

## Introduction

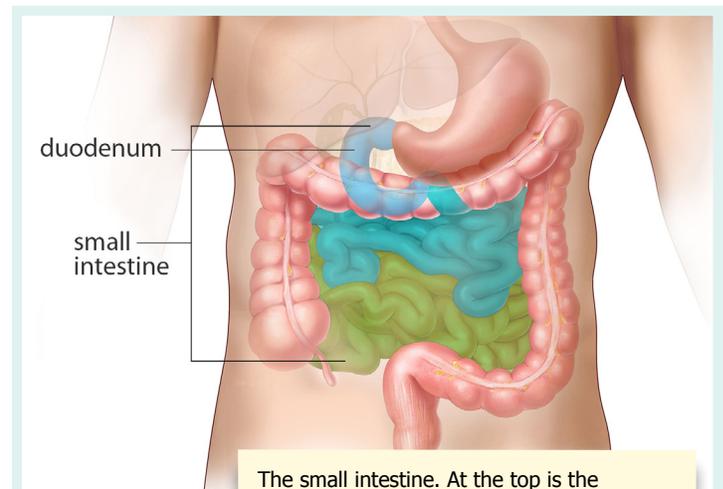
The **microbiome** in our small intestine has a huge impact on how our body works. For example, it affects our metabolism and our immunity to diseases. Because of this, it is important to look after ourselves and eat the right nutrients. If our gut bacteria are happy, then our bodies will be happy, too!

The small intestine in an average adult is about 20 feet (6 meters) in length. That's 3 or 4 times a person's height! Its large surface area is important for **nutrient absorption** and **immune function**. Studying its microbiome can help us understand human health and disease.

There are hundreds (possibly even thousands!) of species of bacteria in our gut microbiome. This means that our gut microbiome is incredibly diverse. But as we get older, the diversity of the gut microbiome decreases. This can lead to conditions such as type 2 diabetes and cardiovascular diseases. Different lifestyle changes can impact our gut microbiome stability. These include medications and changes in diet and exercise.

People who live longer lives have been found to have a more diverse gut microbiome.

Does aging affect the diversity of our gut bacteria and which species are present? This is what we wanted to find out. We also investigated if diseases and medication might affect our gut microbiome.



The small intestine. At the top is the duodenum, where we took our samples from.

Image: Terese Winslow.

## Methods

Other studies have explored gut microbiome diversity by looking at stool samples. But we decided to study samples from the small intestine. We thought this would give a more accurate representation of the bacteria that affect our nutrient absorption and immune function. We collected 251 samples from people between the ages of 18 and 80. We took fluid samples from the **duodenum** of their small intestines by using a **catheter** while they were undergoing a

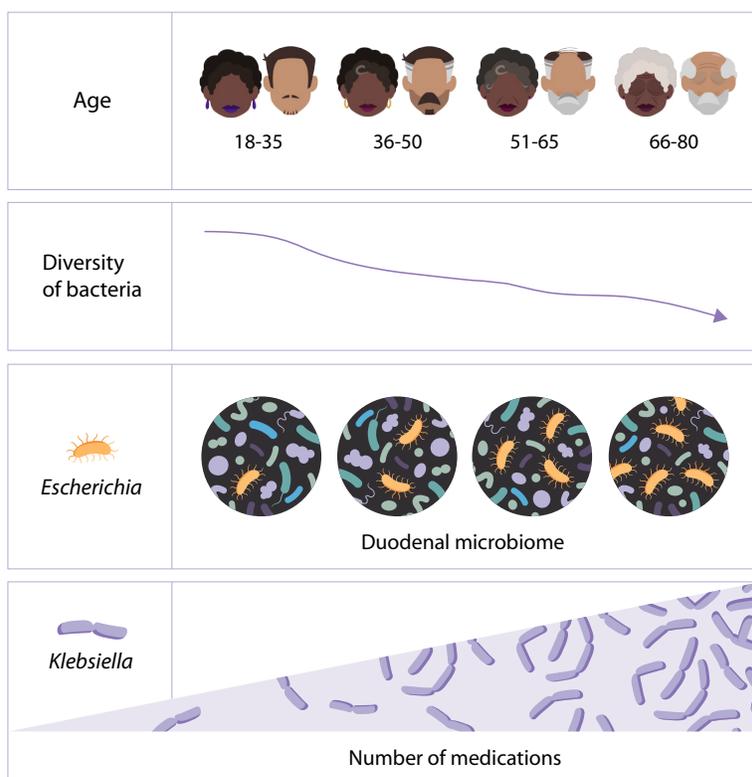
medical procedure called an **endoscopy**.

For each sample, we counted the number of bacterial colonies and also isolated the bacterial DNA. Then we sequenced the bacterial DNA. This revealed which types of bacteria were present. This process allowed us to measure the diversity more accurately. We checked our results with computer programs to make sure we were correct.

## Results

We learned a lot about the gut microbiome in the small intestines of people of different ages (Figure 1). We found that:

1. The number of different bacterial species was smaller in older people. So the diversity of the gut microbiome reduces with age.
2. The number of medications used and the number of diseases present increases with age.
3. In people who were on more medications, there was an increase in certain bacteria known as coliforms. The number of coliform bacteria called *Klebsiella* increased when the person took more medication.
4. Another type of coliform bacteria known as *Escherichia* increased with age in general.
5. In people who had more diseases, a different type of bacteria called *Clostridium* increased.



**Figure 1:**

Bacterial diversity changes with aging. In younger people, there are more kinds of bacteria but a lower presence of *Escherichia* and *Klebsiella* bacteria. Younger people also generally have fewer health conditions and do not take as much medication.

What happens to the diversity of bacteria as we age?

## Discussion

A more diverse gut microbiome means that we have a wider array of different bacteria present. If one type of bacteria is not able to do its job, then the other types can help out, too! This **diversity allows our gut microbiome to function better**. Having less gut microbiome diversity can affect us in negative ways.

Unfortunately there are many ways our microbiome diversity can start to decrease. **Our findings show that gut microbiome diversity in the small intestine decreases with age**. Our results also showed us that medications and illnesses can affect the types of bacteria that can survive in our gut. Other research

has shown that other lifestyle factors, like smoking or drinking alcohol, can affect your gut bacteria as well.

One limitation of our experiment was that the participants had had an endoscopy because of intestinal problems. Because of this, our samples might not represent the average population overall. This means our results might not be exactly the same as what gut microbiome diversity looks like in people in general. More research is needed!

## Conclusion

No matter your age, it's a good idea to try to encourage a diverse gut microbiome so you can be healthier. If our gut bacteria are happy, they will make sure to look after us! Here are a few easy steps to take:

- Try to eat a wide variety of fruits and vegetables every week. Different fruits and vegetables offer different nutrients and support different types of gut bacteria.

- Eat a high-**fiber** diet. Besides fruits and vegetables, oats and beans are excellent sources of fiber!
- Don't take antibiotics unless a doctor prescribes them. They are hard on your gut bacteria, and unnecessary use also makes them less effective over time.

## Glossary of Key Terms

**Catheter** – a tool used for removing fluid from the body by inserting a flexible tube through a narrow opening.

**Duodenum** – the first part of the small intestine. This part helps to digest food from the stomach and to absorb any nutrients.

**Endoscopy** – a test to look inside the body, usually with a tiny camera.

**Fiber** – a type of carbohydrate the body can't use for fuel. Fiber helps move waste through your digestive system and offers a variety of other benefits.

**Immune function** – resistance to infection.

**Microbiome** – a community of microorganisms living together in a particular environment.

**Nutrient absorption** – the process the body uses to bring in nourishment essential for maintaining life and for growing.

## Check your understanding

1 Why is our gut microbiome important?

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2 How do you think your gut microbiome diversity might change as you get older? Why?

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3 Which kinds of bacteria are likely to be present in the gut microbiome of an older person who has a few different diseases and is taking several medications?

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4 We know that some bacteria are harmful, but also that our microbiome needs to have diversity of bacteria in order to be healthy. Can you think of other examples in Nature where many species work together to create a healthy ecosystem? Describe how the species rely on each other and serve different functions.

If time allows, work with a partner to create a poster to present to your classmates.

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## REFERENCES

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