

Press Release

February 3, 2022

2.5 million euros for AI-assisted research into the relationship between the microbiome and the aging process

Fungi, bacteria, archaea and viruses – trillions of microorganisms colonize the skin, mucous membranes and organs of humans. Together, they constitute the microbiome. They maintain health, but can also make us ill. The Leibniz Institute on Aging – Fritz Lipmann Institute (FLI) in Jena will receive 2.5 million euros from the Carl Zeiss Foundation to advance microbiome research. To this end, a research group will be established to develop and apply new data science methods to explore how changes in the microbiome are associated with health and illness during aging.

Jena. Every living thing is colonized by microbes – fungi, bacteria, archaea and viruses. Together, these make up the microbiome. The human microbiome is composed of trillions of microorganisms that colonize the skin and mucous membranes, forming a metabolically active defense layer against pathogens that is essential for individual health. The composition of the microbiome is unique to each person, and it changes depending on external influences such as diet, infections or contact with other people. Recent findings have shown that the human microbiome also undergoes important changes during the aging process. The ecosystem formed by the human host and its microbes can shift out of balance, just like other ecosystems, causing disease and increasing the risk of death.

The balance of the human-microbe ecosystem is at risk in old age

“When the microbiome in the gut loses diversity (i.e. has fewer different types of microorganisms) and becomes dominated by only a few microbial species, pathogens typically join the mix, threatening the host’s health. Infections and inflammatory processes are more likely to occur, triggering a cascade of events that negatively impact the function of several organs, such as the liver and the brain. Such events are more likely to occur in older people,” says Prof. Dario R. Valenzano, who heads the research group “Evolutionary Biology / Microbiome-Host Interactions in Aging” at the Leibniz Institute on Aging – Fritz Lipmann Institute (FLI) in Jena. Together with his colleague at FLI, bioinformatician Prof. Steve Hoffmann, the evolutionary biologist wants to break new ground in understanding how this breakdown in the human-microbe ecosystem leads to disease. How do the trillions of microbes relate to each other and to the body’s cells? To this end, the FLI is establishing a new junior research group in 2022: “AI-based microbiome analysis in aging.” In line with its focus on artificial intelligence, the Carl Zeiss Foundation is funding the project with 2.5 million euros over five years.

New methods for disease prediction

The new research group will develop and apply machine learning and artificial intelligence (AI) methods to gain new insights from biological data. The aim is to use a combination of different methods of data analysis to develop models that allow conclusions to be drawn about the state of disease or health based on the composition of the microbiome.

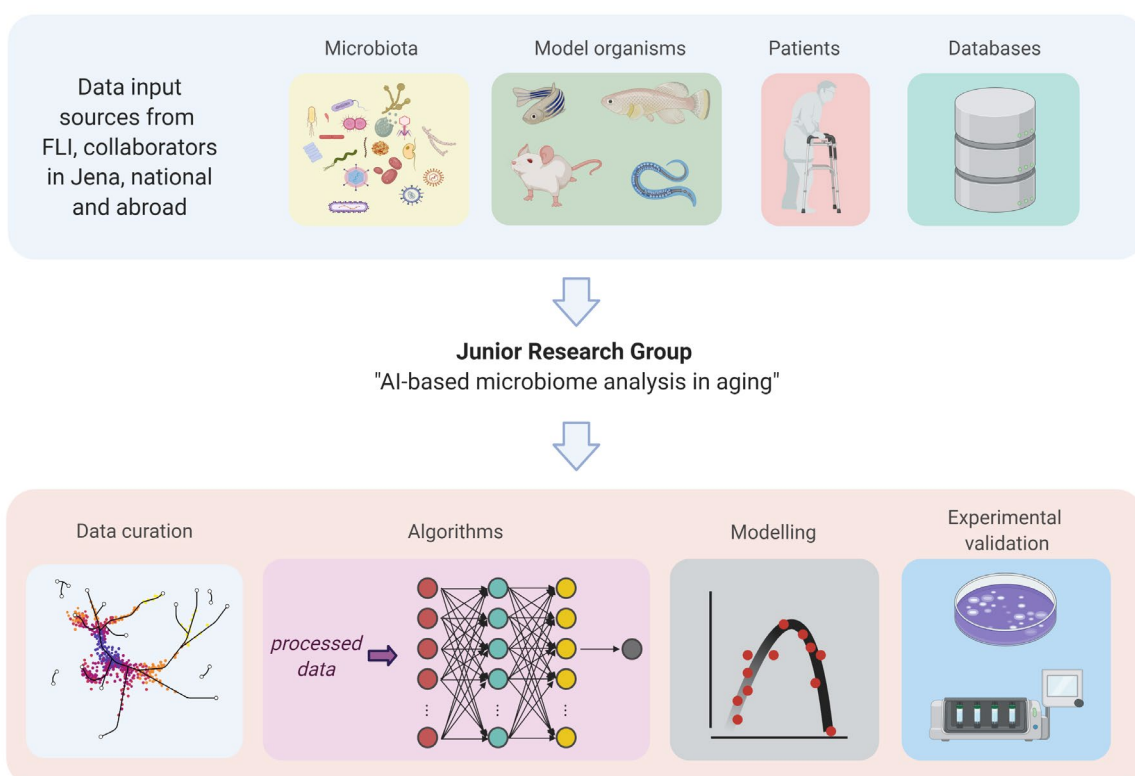
“In the future, such methods could be increasingly used in the diagnosis of colorectal cancer or inflammatory bowel diseases,” says Steve Hoffmann, who heads the research area “Computational and Systems Biology of Aging” at the FLI. “AI methods can also help us analyze changes in the composition and function of microbiome components over time. This temporal dimension is of course the most important to us; after all, we only age over time,” Hoffmann points out.

The data to “train” such AI-based prediction models have been generated by scientists at the FLI for decades. These include, for example, long-term data series on the transcriptome (the totality of genes transcribed in a cell) during aging, as well as data on the influence of the microbiome on epigenetic changes and data on the composition of fecal samples taken from fish and mice throughout their lifespan.

More insights through better analysis of research data

“Incorporating machine learning methods into microbiome research and aging research provides a tremendous increase in the knowledge that can be gained from complex data collections,” notes Prof. Alfred Nordheim, Scientific Director of the FLI. “We are very grateful to the Carl Zeiss Foundation for supporting this important development at FLI.”

Picture



Overview of the scientific concept for the Junior Research Group. The new research group will develop AI-based methods to study functional interactions between multi-dimensional aging and microbiome data sets. (Graphic: FLI / Dario Valenzano; created with www.Biorender.com)

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Background information

The **Leibniz Institute on Aging – Fritz Lipmann Institute (FLI)** – upon its inauguration in 2004 – was the first German research organization dedicated to research on the process of aging. More than 350 employees from around 40 nations explore the molecular mechanisms underlying aging processes and age-associated diseases. For more information, please visit www.leibniz-fli.de.

The **Leibniz Association** connects 97 independent research institutions that range in focus from natural, engineering and environmental sciences to economics, spatial and social sciences and the humanities. Leibniz Institutes address issues of social, economic and ecological relevance. They conduct basic and applied research, including in the interdisciplinary Leibniz Research Alliances, maintain scientific infrastructure, and provide research-based services. The Leibniz Association identifies focus areas for knowledge transfer, particularly with the Leibniz research museums. It advises and informs policymakers, science, industry and the general public. Leibniz institutions collaborate intensively with universities – including in the form of Leibniz ScienceCampi – as well as with industry and other partners at home and abroad. They are subject to a transparent, independent evaluation procedure. Because of their importance for the country as a whole, the Leibniz Association Institutes are funded jointly by Germany's central and regional governments. The Leibniz Institutes employ around 20,500 people, including 11,500 researchers. The financial volume amounts to 2 billion euros. For more information: www.leibniz-gemeinschaft.de/en/.

The **Carl Zeiss Foundation's** mission is to create an open environment for scientific breakthroughs. As a partner of excellence in science, it supports basic research as well as applied sciences in the STEM subject areas (science, technology, engineering and mathematics). Founded in 1889 by the physicist and mathematician Ernst Abbe, the Carl Zeiss Foundation is one of the oldest and biggest private science funding institutions in Germany. It is the sole owner of Carl Zeiss AG and SCHOTT AG. Its projects are financed from the dividend distributions of the two foundation companies.