As the population ages, an increasing number of older adults are affected by the so-called frailty syndrome. This is a condition in which the body loses its ability to effectively respond to stressors such as infections, falls, or hospitalizations. People living with frailty become fatigued more quickly, experience physical and mental weakness, are hospitalized more frequently, and cope worse with chronic diseases. This condition significantly lowers the quality of life for both patients and their families and places a substantial burden on the healthcare system. Importantly, there are still no effective methods to prevent or treat frailty.

One emerging hypothesis suggests that iron deficiency may be an important factor contributing to the development of frailty. Iron plays a key role in cellular energy production—especially within the mitochondria, known as the "powerhouses" of cells. Without sufficient iron, cells—including muscle and brain cells—function less efficiently, which may lead to reduced strength, physical performance, and mental resilience. Iron deficiency is also common in older adults, due to both poor diet and impaired absorption.

The aim of the FRAIL-NUTR project is to gain a comprehensive understanding of frailty in the elderly and to investigate the role of iron deficiency in its development. The study will characterize different types of frailty, taking into account not only physical aspects but also social, psychological, and cognitive factors. A key component will be the detailed assessment of iron status in older individuals, using both standard and novel biomarkers, as well as advanced diagnostic techniques. The project also aims to identify the causes of iron deficiency—including the role of diet, gut health, intestinal microbiota, and potential iron loss through urine. Ultimately, it seeks to determine whether improving iron status—through individualized dietary intervention or supplementation—can enhance physical performance, well-being, and overall quality of life in older adults.

The project consists of three parts:

- **A:** an observational study of 400 seniors assessing health status, physical performance, and iron levels;
- **B:** a 12-month dietary program for 80 individuals with iron deficiency;
- **C:** a clinical trial testing the effectiveness of oral vs. intravenous iron supplementation in 120 participants.

This research may pave the way for new strategies to support the health of older adults using simple and accessible methods, such as tailored diets or iron supplementation. Its findings could help improve the quality of life for thousands of seniors and ease the burden on healthcare systems.