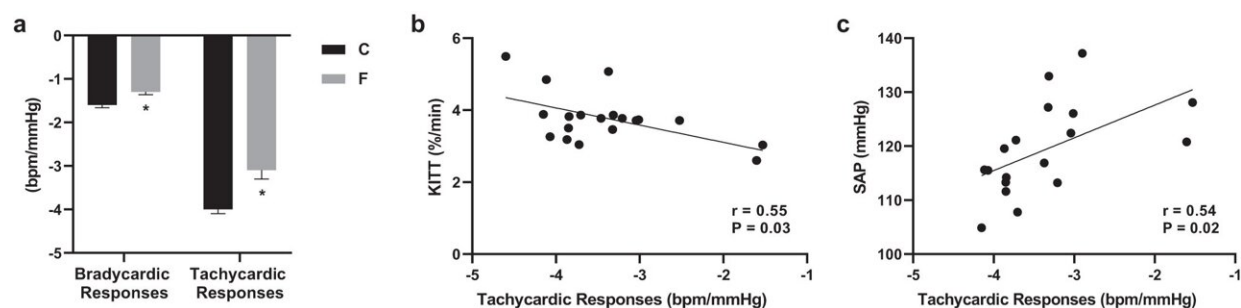


# Overconsumption of fructose by parents increases risk of cardiometabolic disease in offspring, study shows

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Baroreflex sensitivity and correlations in studied groups. Baroreflex sensitivity was evaluated by bradycardic responses and tachycardic responses (a) of offspring of Fructose (F) parents and offspring of Control (C) parents. Pearson correlations between tachycardic responses of baroreflex sensitivity and KITT (b) and SAP (c). \* $p \leq 0.05$  when compared to C. Credit: *International Journal of Obesity* (2023). DOI: 10.1038/s41366-023-01409-y

Offspring of rats that consume excessive amounts of fructose develop disturbances in the autonomic nervous, cardiovascular, and metabolic systems at an early age, increasing the risk of chronic diseases such as diabetes and obesity in adulthood, according to a study conducted by Brazilian scientists. The study is [published](#) in the *International Journal of Obesity*.

The findings confirm information in the scientific literature regarding the appearance of metabolic disorders such as high levels of triglycerides (150 mg/dL or more) and insulin resistance in the offspring of parents that overconsume fructose. In addition, the offspring in the study exhibited an increase in blood pressure and impairment of the baroreflex, a physiological mechanism that helps keep blood pressure stable.

Although fructose is naturally present in fruit, honey, and some vegetables, it is a simple sugar (monosaccharide) widely used as a food and beverage sweetener. High-fructose corn syrup is an ingredient in soft drinks, cakes, candy, and cookies. It sweetens 20%-80% more than pure glucose. Overconsumption of fructose has been associated with the high prevalence of overweight and obesity in the world population, including children.

"Medicine has had to concentrate on firefighting for too long—acting after the disease is already there. We now have enough elements and scientific research for preventive medicine. Future generations will have to face this time bomb unless we make prevention effective," said Kátia De Angelis, corresponding author of the article and a professor of physiology at the Federal University of São Paulo (UNIFESP) in Brazil.

She was the Ph.D. thesis advisor for first author Camila Paixão dos Santos in UNIFESP's Translational Medicine Program.

For De Angelis, the study reinforces the importance of the autonomic nervous system (ANS) to the regulation of many functions in the body and its potential to signal a child's susceptibility to this type of disease in adulthood. The ANS automatically regulates involuntary functions such as heart rate, blood pressure, breathing, digestion, and temperature.

## **Obesity pandemic**

Over half the world population, or more than 4 billion people, are set to be overweight or obese by 2035 unless meaningful action is taken to address the problem, according to World Obesity Atlas 2023, which puts the annual rise in numbers of overweight and [obese adults](#) and children at 2.8% and 4.4% respectively.

In Brazil, 41% of adults are expected to become obese by 2035, up from 17.1% currently, according to a survey by the Brazilian Health Ministry (Covitel 2023—Telephone Survey on Risk Factors for Chronic Non-Communicable Diseases During the Pandemic). The Brazilian Diabetes Society estimates that between 60% and 90% of diabetics are also obese and that the proportion is especially high among over-40s.

"Of course, overconsumption of fructose isn't the only factor in obesity, but it's been accompanied by growth in the proportion of the population who are overweight and obese," De Angelis said.

Fructose is metabolized in the liver, and large amounts of the monosaccharide can increase [fatty acid synthesis](#) there, leading to a buildup of triglycerides and a rise in body weight, which in turn is associated with a rise in the inflammatory molecules involved in the development of other diseases.

According to the American Heart Association (AHA), a healthy diet should limit sugar intake to 100 calories (26 g) per day for women and 150 calories per day (39 g) for men. For comparison, a 350 ml soft drink contains 38 g of sugar. The World Health Organization (WHO) recommends that sugar be limited to 10% of daily calorie intake (50 g or about ten teaspoons for an intake of 2,000 calories, for example).

## **Accumulated knowledge**

De Angelis heads the Brazilian Society of Hypertension (SBH) and teaches graduate students at UNIFESP and Nove de Julho University (UNINOVE). She has studied aspects of cardiovascular disease, diabetes and obesity for 20 years.

An article by De Angelis and collaborators published in the [\*American Journal of Physiology\*](#) in 2012 showed that adult mice submitted to chronic fructose overconsumption developed insulin resistance as well as hemodynamic and autonomic dysfunctions associated with an inflammatory profile. Their [systolic blood pressure](#) became elevated a fortnight after starting the high-fructose diet.

"We were surprised by the effect of a small rise in blood pressure accompanied by a sharp rise in sympathetic modulation on their cardiovascular system."

"What surprised us was that the rise in sympathetic modulation happened before any metabolic changes, such as alterations in levels of glucose and triglycerides, for example, based on the classical clinical measurements made by physicians. Blood pressure hardly changed, but sympathetic hyperactivity was already very much present. This served as a warning about ANS dysfunction controlling the viscera," De Angelis told Agência FAPESP.

In the more recent study, the rats were given drinking water with 10% fructose for 60 days before mating, and their offspring were assessed 30 days after weaning.

Lower birth weight, increased levels of triglycerides, and [insulin resistance](#) were observed in the offspring compared to controls, as well as elevated blood pressure and baroreflex sensitivity impairment, characterized by reduced bradycardic and tachycardic responses (meaning that heart rate deceleration and acceleration did not occur as

they should). The baroreflex impairment was associated with reduced insulin tolerance and elevated systolic blood pressure.

"What we showed was a mechanism for early detection of dysfunctions," De Angelis explained.

"We're trying to alert physicians to the need to evaluate children before elevated [blood pressure](#) or metabolic dysfunction is diagnosed so that earlier signs such as those associated with the ANS can be detected. If children or parents are exposed to high levels of fructose, the children are likely to develop dysfunctions in adulthood. If we can detect the signs early enough, it may be possible to attenuate or delay the appearance of disease."

The researchers are now evaluating therapeutic alternatives and the effects of physical exercise. Previous studies by the group demonstrated the benefits of exercise training on animals that consumed fructose from infancy or in adult life.

**More information:** Camila Paixão dos Santos et al, Parental fructose consumption induces early baroreflex dysfunction in offspring: impact on arterial pressure and on insulin resistance, *International Journal of Obesity* (2023). [DOI: 10.1038/s41366-023-01409-y](https://doi.org/10.1038/s41366-023-01409-y)

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