Functional magnetic resonance imaging of human hypothalamic responses to glucose, fructose, sucrose, and sucralose.

Published: 26-01-2015
Last updated: 21-04-2024

Primary objective of the exploratory study is to assess whether the BOLD signal intensity of the hypothalamus differs between the different sugars and sweeteners of glucose, fructose, sucrose and sucralose.

Ethical review	Approved WMO
Status	Recruitment stopped
Health condition type	Other condition
Study type	Observational non invasive

Summary

ID

NL-OMON42119

Source
ToetsingOnline

Brief title
fMRI of hypothalamic response to sugars and sweetners

Condition

- Other condition

Synonym
healthy volunteers

Health condition

gezonde vrijwilligers

Research involving

Human

Sponsors and support

Primary sponsor: Unilever
Source(s) of monetary or material Support: Unilever R&D Vlaardingen

Intervention

Keyword: fMRI, hypothalamus, nutriënt sensing, sugars

Outcome measures

Primary outcome

BOLD signal intensity changes of the hypothalamus after ingestion of 5

different stimuli of 300ml each: tap water, 50gr glucose solution, 50 gr

fructose solution, 50gr sucrose solution and 0,1gr sucralose solution.

Secondary outcome

Psychophysical ratings of hunger, taste and sweetness

Study description

Background summary

Obesity is becoming an increasingly prevalent problem. A cause of obesity is aberrant feeding behavior. Taste of food plays an important role in the palatability of food and the hedonic benefits in consuming them. The hypothalamus is a subcortical structure that plays a key role in the intricate and complex neuroendocrine interactions that govern food intake and energy homeostasis. Using functional magnetic resonance imaging (fMRI) we have previously measured the hypothalamic function during nutrient ingestion. In healthy humans, an oral glucose load decreases hypothalamic neuronal activity, whereas no such response was observed in patients with type 2 diabetes and a delayed and attenuated response in obese participants. This indicates that in these patients, the hypothalamus inappropriately perceives and/or processes signals in response to a nutrient load, possibly reflecting an abnormal perception of the current metabolic status. In most foods, however, taste is being enhanced not by glucose but by sucrose and fructose (HFCS flavourings - high fructose corn syrup), which are much cheaper additives. From dietary point

of view, the hypothalamic responses of these specific sugars are unclear. Glucose is a monosaccharide and rapidly taken up in the blood and metabolized throughout the entire body. Our previous data even have shown that that the administration of glucose results in a hypothalamic response that is much faster than is expected based on an pure abdominal pathways. Fructose has a sweetness that is a little higher than glucose, is also a monosaccharide, but can only be metabolized in the liver. From food/obesity homeostatic point of view, we do not expect that fructose induces a decrease in hypothalamic neuronal activity, and will therefore not be involved in hypothalamic response/decisions *to eat or not to eat*. Sucrose, better known as table sugar is a disaccharide composed of the monosaccharides glucose and fructose. This disaccharide is broken down in the stomach into separate glucose and fructose monosacchrides by the enzyme sucrose. Sucrose has a similar sweetness compared with glucose and fructose. We expect that the hypothalamic response of sucrose is less than glucose based on molecular weight and the previous effects of hypothalamic BOLD response dose dependency, and will occur later since the disaccharide has to be broken down first. For control conditions we will use plain water (no taste / no calories) and sucralose, which is a non-caloric sweetener. Our overall hypothesis is that glucose demonstrates the fastest and deepest hypothalamic response, followed by sucrose. The effects of fructose and sucralose will be much less but may have a Pavlov effect on the hypothalamus, based on its sweet taste. The water condition is the absolute *0* and reference in all these studies.

Study objective

Primary objective of the exploratory study is to assess whether the BOLD signal intensity of the hypothalamus differs between the different sugars and sweeteners of glucose, fructose, sucrose and sucralose.

Study design

The study design is a randomized cross-over observational study in healthy male volunteers.

Study burden and risks

The study will consist of five occasions. There will be an interval of at least one week between the occasions. On all occasions, the subject will be admitted to the Clinical Research Unit of the LUMC. After anthropometric measurements (weight), fMRI to monitor hypothalamic activity will be performed after an ingestion of 1 of the following stimuli; water at room temperature, glucose (50 gram dissolved in 300 ml water), fructose (50 gram dissolved in 300 ml water), sucrose (50 gram dissolved in 300 ml water), or sucralose (0.1g; matched for sweetness with sucrose, dissolved in 300 ml water). Water will be plain tap water and non-chlorinated. The order of conditions will be randomly assigned to

the subjects. The hypothalamus will be continuously imaged for 20 minutes using a conventional T2*-weighted gradient-echo pulse sequence.
Before and after the MRI 5ml of blood will be drawn and subjects will be asked to give psycophysical ratings of hunger, taste and sweetness.

Contacts

Public
Unilever

Olivier van Noortlaan 120
Vlaardingen 3133AT
NL
Scientific
Unilever

Olivier van Noortlaan 120
Vlaardingen 3133AT
NL

Trial sites

Listed location countries

Netherlands

Eligibility criteria

Age
Adults (18-64 years)
Elderly (65 years and older)

Inclusion criteria

-Signed informed consent
-Age between 18 and 25 years
-BMI between 20 and 24kg/m2
-Length between 170 and 190 centimeters

Exclusion criteria

-Diabetes
-Any genetic or psychiatric disease (e.g. fragile X syndrome, major depression) affecting brain
-Any significant chronic disease
-Renal or hepatic disease
-Recent weight changes or attempts to lose weight (> 3 kg weight gain or loss, within the last 3 months)
-Smoking (current or last 6 months)
-Alcohol consumption of more than 21 units per week or use of recreational drugs at present or in the last year
-Recent blood donation (within the last 2 months)
-Recent participation in other biomedical research projects (within the last 3 months), participation in 3 or more biomedical research projects in one year
-Contra-indication to MRI scanning

Study design

Design

Study type:	Observational non invasive
Intervention model:	Crossover
Masking:	Single blinded (masking used)
Control:	Uncontrolled
Primary purpose:	Diagnostic

Recruitment

NL

Recruitment status:	Recruitment stopped
Start date (anticipated):	17-02-2015
Enrollment:	16
Type:	Actual

Ethics review

Approved WMO

Date:	26-01-2015
Application type:	First submission
Review commission:	METC Leids Universitair Medisch Centrum (Leiden)

Study registrations

Followed up by the following (possibly more current) registration

No registrations found.

Other (possibly less up-to-date) registrations in this register

No registrations found.

In other registers

Register	ID
CCMO	NL51275.058.14