Project Acronym: NUTRISHIELD

Grant Agreement number: 818110 (H2020-SFS-2018-IA)

Project Full Title: Fact-based personalised nutrition for the young

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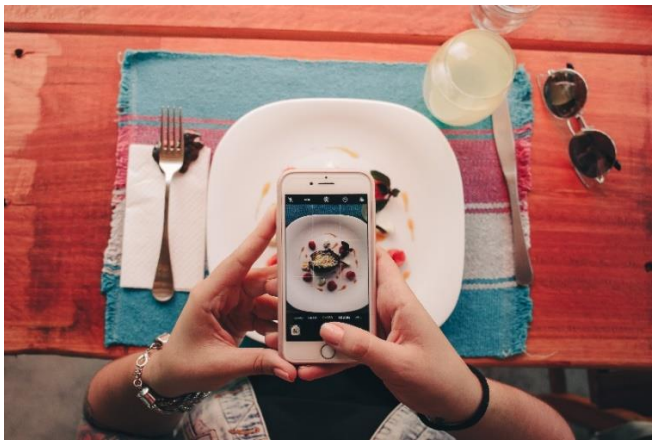
Case Study III: Personalised nutrition of young individuals, from 8 to 10 years of age, aiming at avoiding the development of cognitive decline



Objectives & Results

Diet affects the gut microbiome that in turn responds by producing specific metabolites. Some of them can be found in breath, as they are carried by blood into the lungs and then exhaled.

For instance, a diet high in fiber and fermented foods can promote the growth of beneficial gut bacteria. As such, the microbiota releases by-products and secondary metabolites from dietary components that can serve as an excellent indicator for assessing diet-induced metabolic changes. Among these metabolites is the group of short-chain fatty acids (SCFAs) from which acetic, propionic and butyric acid make up 95% of the SCFAs produced in the gut. They constitute the main source of nutrition for the cells in the colon and performance an important role in the human health and additionally, are able to cross the blood-brain barrier and interact with specific receptors in the central nervous system to modulate neural function and behaviour. For example, the cognitive function of the brain may be influenced by diet in conjunction with other components of everyday life, such as exercise or stress.

One way to investigate the changes in the metabolism is via exhaled breath. Breath analysis is particularly suitable for children, as it is non-invasive and safe.

The main goal of the NUTRISHIELD Study III is to assess the (co)relation between the biomarkers from exhaled breath and dietary quality. The latest was determined via the nutritional status measures conducted at Donders Institute partner within the ERDF-funded project PROJ-00405: “BriteN”.

The data to be processed include breath analysis and the nutritional status of the individuals defined by

- a composite score of adherences to the Dutch Healthy Diet index (DHD-index) (derived from a Food Frequency Questionnaire, FFQ) and
- by visceral adipose tissue –VAT (measured with abdominal MRI), as well as
- by body mass index - BMI resulted from anthropometric measures.

In addition, the breath correlation with the data on the cognition tasks from the BriteN, namely the Flanker Task was examined, as a well-known cognitive psychology experiment that measures a person's ability to focus their attention and quickly process information.

Several targeted and untargeted volatile compounds present in the breath of children have been investigated in relation to the nutritional status. These include methane, hydrogen, ethylene, short-chain fatty acids, acetone, acetaldehyde, ethanol, isoprene, etc.

The breath collection is simple, and the children were not exposed to any risks when participating in this study.

Breath samples from 8-10 year old children's were collected in 3-liter Tedlar® sample bags using a commercial breath sampler that has been previously employed in multiple studies. Several instruments were used for the volatile analysis; laser-based systems for detection of methane and ethylene and proton-transfer reaction time of flight mass spectrometer for untargeted analysis.

Data from breath analysis and the nutritional status were used for multivariate modelling in collaboration with Cranfield University partner. Several breath VOCs such as acetaldehyde, methane and propionic acid showed a predictive value in relation to BMI.

In addition, it was discovered that VAT was moderately correlated to SCFAs especially the propanoic acid, but it also strongly correlated to ethylene, implying that increased VAT might result in an inflammatory response. The DHD total score was significantly correlated to ethanol and SCFAs. This correlation may indicate that adherence to a healthy diet is associated with a shift in the composition of the gut microbiome and an increase in beneficial gut bacteria. Several breath volatiles appeared interesting correlations with the Flanker task results, suggesting their potential as biomarkers for cognitive function.

In summary, the results of this study revealed that breath analysis is a promising and non-invasive tool for monitoring the impact of dietary quality on gut function in children and the effect of diet on cognition development.

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