The NUTRIOME study: Precision nutrition and postprandial immune response

Published: 17-02-2025
Last updated: 07-03-2025

To acquire metabolic health data from three dietary challenge meals for the development of an algorithm for personalised dietary advice, and subsequently test the effectiveness of this personalised dietary advice compared to a general healthy diet...

Ethical review	Approved WMO
Status	Pending
Health condition type	Glucose metabolism disorders (incl diabetes mellitus)
Study type	Interventional

Summary

ID

NL-OMON57308

Source
ToetsingOnline

Brief title
NUTRIOME

Condition

- Glucose metabolism disorders (incl diabetes mellitus)
- Lipid metabolism disorders

Synonym
diabetes, Impaired glucose tolerance

Research involving
Human

Sponsors and support

Primary sponsor: Wageningen Universiteit
Source(s) of monetary or material Support: Europese Unie;HORIZON Europe (MSCA)

Intervention

Keyword: Postprandial glucose responses, Postprandial inflammation, Postprandial lipid responses, Precision nutrition

Outcome measures

Primary outcome

The primary outcome parameters are the differences in postprandial glucose, triglyceride, and IL-6 response to a high-fat mixed-meal (HFMM) test following 6 weeks of intervention with personalised dietary advice compared to 6 weeks of a control dietary advice.

Secondary outcome

Our secondary outcomes in Phase 1 include differences in 1) metabolic factors, 2) gut microbiota 2) immune health, 3) microbiota and gut health, 4) underlying biological mechanisms and 5) wellbeing between meals. The specific outcomes related to these objectives are shown in Table 1. We further aim to explore determinants of response/no response to meals in metabolic factors using microbiota, epigenomics, transcriptomics and metabolomics data, as well as differences in appetite between meals.

Our secondary outcomes in Phase 2 include differences in metabolome, epigenome, transcriptome, and gut microbiota between personalised diet vs general healthy diet. We will also consider differences in metabolic health score between personalised diet vs general healthy diet and evaluate the predicted response/non-response to personalised vs general diet in Phase 2 based on metabolomics, gut microbiome, epigenomics, transcriptomics, health, metabolic

and dietary data at baseline.

In addition, workflows will be built on data from both phases in which multi-layered nutrition data will be assessed, combined and analysed to dissect the underlying mechanisms behind response/non-response to diet. Furthermore, differences in putative food intake biomarkers to validate compliance to personalised diets in Phase 2 will be conducted. This includes also effects of the intervention on epigenome- and transcriptome-wide effects in PBMCs isolated from fasting samples.

1) Metabolic health

Differences in response following the Phase 1 test meals on:

a. Blood glucose;

b. Blood lipid spectrum;

c. Levels of inflammation markers;

d. Blood glucose, lipid and inflammation markers as measured at-home;

e. Circulating metabolites before and after a HFMM under fasting and postprandial conditions;

Differences in response following Phase 2 HFMM tests on:

a. Blood glucose, lipid and inflammation markers as measured at-home;

b. Circulating metabolites before and after a HFMM under fasting and postprandial conditions;

2) Immune health

a. PBMC epigenome -and transcriptome;

b. Blood immune and immune metabolism markers and immune cell populations;

3) Gastro-intestinal microbiome and gut health

a. Faecal microbiota composition;

b. Microbial metabolites;

d. Microbiome functionality and proteome;

f. Gastro-intestinal symptoms;

g. Gastro-intestinal transit time;

4) Biological mechanisms

a. Metabolomics in blood and morning spot-urine;

b. Blood transcriptomics and proteomics;

5) General wellbeing

a. Effects on satiety.

Study description

Background summary

Suboptimal diet is an important risk factor for the development of non-communicable diseases, such as stroke, diabetes or colon cancer (conditions often related to metabolic disturbance and low-grade inflammation) which are major drivers of mortality and morbidity, thus contributing to the global burden of disease. Precision nutrition - i.e. tailoring diet to the right individual at the right time, based on individual factors (e.g., genes, metabolic profile, environmental factors or gut microbiota) - could potentially lead to the development of more effective diet-based disease prevention

strategies. Although nutrition and lifestyle factors play a critical role in disease prevention, individuals do not necessarily respond in the same way to dietary or lifestyle changes. This highlights the need for better understanding of the determinants of inter-individual differences in response to food.

Since humans spend a substantial portion of each day in a postprandial state, individual metabolic and inflammatory responses to meals are likely to play a role in the pathophysiology of diet-related diseases. Although there are data on postprandial glucose response to meals, there is limited data on postprandial inflammatory responses and to what extent diet can be tailored to individuals for long-term health benefits, depending on their postprandial metabolic and inflammatory responses. Further, studies that reported on differential individual responses to intervention foods often utilised drinks or single foods high in fat or sugar that would not fit into the framework of a *healthy and sustainable food system* and the response to such foods may be different compared to foods that are more similar to what people consume in their daily life.

Study objective

To acquire metabolic health data from three dietary challenge meals for the development of an algorithm for personalised dietary advice, and subsequently test the effectiveness of this personalised dietary advice compared to a general healthy diet based on national dietary guidelines on cardiometabolic health. Secondarily, determinants of individual dietary responses will be investigated.

Study design

The study is a multi-centre study, conducted in Gothenburg (Sweden), Oslo (Norway) and Wageningen (Netherlands). The study will be conducted in two phases that are separated by approximately 7-9 months. In Phase 1 of the study, participants will undergo three meal challenges in a crossover design, that are each separated by at least five days. The order of the meals will be set randomly according to a Latin square design. In Phase 2, the participants will be randomised into receiving either personalised nutrition advice or general dietary advice. The algorithm will be developed using the response pattern to the three different test meals in Phase 1 and current knowledge about the impact of specific foods on such responses. All participants in the general dietary advice group will receive dietary advice based on official dietary guidelines in the three countries. Dietary advice will largely be within the normal range of official dietary guidelines. Prior to the start of the intervention, several measurements, including glucose and haemoglobin capillary blood tests and anthropometrics, will be performed.

Intervention

During Phase 1, participants will be provided with three intervention meals. They will consume one study meal each week at the clinic in the morning. The three different intervention meals are isocaloric, but based on different food sources (plant-based, fish-based, and meat-based) and differ in nutrient composition. The plant-based meal is a carbohydrate-rich meal and the fish -and meat-based meals differ in fat quality. All meal compositions are within the range of a normal diet. The foods used in the study are commercially available foods and do not confer any risks.

During Phase 2, all participants are randomly assigned to one of two diets, which will be either personalised dietary advice or a control diet, based on healthy dietary guidelines across the three participating countries. The personalised dietary advice will be based on an algorithm considering the individuals* postprandial glucose, triglycerides and inflammation markers in response (low, medium, high response group) to each of the three study meals in Phase 1, matched with established knowledge about the effects of specific foods on such metabolic parameters. There will be no specific meals provided for the intervention during Phase 2.

Study burden and risks

Burdens that the participants may experience include the time they need to invest in the study and the dietary/lifestyle restrictions during the two intervention periods. The total study duration for a participant will be approximately 10 months, including a 7-month break. The total time that needs to be invested by participants in this study during visits is approximately 38 hours, of which 24 hours during Phase 1 and 14 hours during Phase 2.

While participating in the study, participants will be required to eat standardised meals for a total of eight days during the study (standardised dinner meal before each of the meal test -and HFMM visits; the three meal tests themselves) as well as limit their physical activity for three days around each meal test. This can cause limited inconvenience to the participants.
All study meals provided in this study are prepared from commercially available foods and should not cause any major gastrointestinal or other symptoms. In Phase 2, the participants will be required to make changes to their habitual diet, depending on the dietary advice that was allocated to them.

The following burdens or risks may be associated with participation:

- Participants will have to wear a continuous glucose monitor (CGM) at two occasions. The placement of the CGM, though minimally invasive, could be considered a burden for the participants. The adhesive from the CGM sensor could cause light skin irrita-tion but no other discomfort is to be expected. The sensor is waterproof, thus, no sani-tary restrictions or restrictions to recreational activities are necessary (with the excep-tion of situations that would expose the sensor to very high temperatures, e.g., sauna, which should be

avoided during the study). We minimise this burden by using a con-tinuous glucose monitor that does not need regular calibration by finger pricks. The placement of the Freestyle Libre will be done by experienced researchers.
- At three occasions during the study, participants will also wear an activity monitor; an accelerometer. The ActiGraph placement is not invasive and has an adjustable band to make wearing it as comfortable as possible.
- During test days, blood will be collected via a venous catheter. Venipunctures can oc-casionally result in a local hematoma or bruise. Some participants in previous studies report pain during venepuncture. The blood collection will be done by experienced nurses. A total of ~900 mL of blood will be drawn over the entire RCT (> 10 month pe-riod), divided in approximately 560 mL during Phase 1 (including baseline) and 340 mL in Phase 2. For conventional blood donations, men donate ~500 mL blood every 2.5 months and women every 4 months.
- The collection and storage of faecal and urine samples can be experienced as a burden. However, based on previous experience, this procedure is quite feasible.
- Throughout the study, questionnaires will be completed and food intake will be recorded periodically by means of an app or computer during daily life, which requires additional time investment.
- The self-administered dry blood-spot samples can cause some discomfort and potentially irritate or bruise the skin around the puncture location.
- The total radiation dose participants will be exposed to during the DXA scan is approximately 0.002 mSv. Since the average annual radiation exposure per person in the Netherlands is ~2.5 mSv per year, the amount of radiation exposure during DXA scans is negligible. Any contraindications for the DXA scan will be checked at screening as well as immediately before the participant undergoes the scan.
- The blue coloured pastries are made from commercially available ingredients, including a food-grade blue dye. No discomfort is to be expected from consuming them, only small temporary staining of the tongue, which will not last >1 hour.
- No risks are known about the OGTT and HFMM test. These measurements are routinely applied in human metabolic research, and SOPs are available in the database of the Human Nutrition department.

Since the prevalence of overweight and cardio-metabolic disorders is continuing to rise, study outcomes could provide future health benefits for the general public. Participants will receive useful information about their health status and the intervention diets that the participants will follow may be advantageous to overall health.

Contacts

Public

Wageningen Universiteit

Stippeneng 4
Wageningen 6708WE
NL
Scientific
Wageningen Universiteit

Stippeneng 4
Wageningen 6708WE
NL

Trial sites

Listed location countries

Netherlands

Eligibility criteria

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

Inclusion criteria

Men and women
Age 40 to 70 years
Body mass index (BMI) 27-35 kg/m2
Signed informed consent

Exclusion criteria

- Medical history of diagnosed cardiovascular disease (e.g. stroke, heart disease)
- Diagnosed type 1 or type 2 diabetes
- Antibiotic use in the last 3 months
- Taking Diabetes drugs; medication like statins, medication to manage hypertension are not grounds for exclusion, if the medication regimen has been stable for the last three months
- Stomach and gastrointestinal conditions (e.g. Morbus Chron, Ulcerative

colitis, irritable bowel syndrome, malabsorption, colostomy, bowel resection, gastric bypass surgery etc.)
- History of major gastrointestinal surgery
- Chronic or acute inflammatory conditions (e.g., rheumatoid arthritis, psoriatic arthritis)
- Thyroid disorders
- Significant renal or liver dysfunction or chronic kidney or liver disease
- Known food allergies/intolerances to intervention foods or food products used in the study
- Following specific dietary regimen that could impact results
- Current or planned pregnancy or lactating
- Other serious medical conditions that could interfere with participation
- Unable to sufficiently understand written and spoken national language (where the study center is located) to provide written consent and understand information and instructions from the study personnel.

Study design

Design

Study type:	Interventional
Intervention model:	Parallel
Allocation:	Randomized controlled trial
Masking:	Single blinded (masking used)
Control:	Active
Primary purpose:	Other

Recruitment

NL

Recruitment status:	Pending
Start date (anticipated):	01-02-2025
Enrollment:	40
Type:	Anticipated

Ethics review

Approved WMO

Date:	17-02-2025
Application type:	First submission
Review commission:	CMO regio Arnhem-Nijmegen (Nijmegen)

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	NL87595.091.24