Maximal fat oxidation during exercise: impact of nutritional status and exhaustion

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We aim to establish the impact of pre-exercise CHO availability and exhaustion on maximal fat oxidation (MFO & FATmax) during exercise

Ethical review	Approved WMO
Status	Recruitment stopped
Health condition type	Other condition
Study type	Interventional

Summary

ID

NL-OMON49381

Source
ToetsingOnline

Brief title
Maximal fat oxidation during exercise - FatMaxx

Condition

- Other condition

Synonym
na

Health condition

niet van toepassing (inspanningsfysiologie)

Research involving
Human

Sponsors and support

Primary sponsor: Wageningen Universiteit
Source(s) of monetary or material Support: Eat2Move consortium (subsidie provincie Gelderland)

Intervention

Keyword: Exercise, Exhaustion, Fat oxidation, Nutrition

Outcome measures

Primary outcome

The main study parameters are the MFO and FATmax as assessed with indirect calorimetry (VO2, VCO2) during a graded exercise test (35W/ 3min protocol). In order to calculate these values oxygen consumption (VO2), and CO2 production (VCO2) are measured. From these values the RER can be calculated, and fat oxidation will be quantified according to by the stoichiometric equations Frayn (1983).

Secondary outcome

Other parameters that can be obtained during the graded exercise test are: peak sustained power output (expressed in Watt), maximal oxygen consumption (VO2max), (maximal) heart rate and the respiratory exchange ratio (RER) during different stages of the graded exercise protocol.

In addition, body composition, training history and dietary intake will be measured

Study description

Background summary

During exercise, energy expenditure increases dramatically, with exercise intensity as the single most important factor influencing substrate utilization. It is commonly reported that fat oxidation increases as exercise intensity increases, up to a certain point. At higher exercise intensities, fat oxidation declines quite rapidly, despite increased energy requirements, and carbohydrate becomes the predominant, and finally the only fuel source during (aerobic) exercise.
The maximal capacity of the human body to oxidize fat during exercise can quantitatively be described by the so-called *MFO* and *FATmax*. The MFO (maximal fat oxidation) is the highest absolute level of fat oxidation as expressed in gram per minute (g/min), while FATmax is the exercise intensity at which fat oxidation is highest (%VO2max or %HFmax). These concepts may have importance for endurance training and performance.
It is well known that, even in quite homogenous populations, inter-individual variability in fat oxidation, in particular MFO, is quite large. Individual factors like gender, body composition (lean mass) and fitness level do explain a substantial part of this variation. In addition, genetic factors do underlie differences between individuals. But also *external factors* like nutritional status, i.e. a low or high carbohydrate (CHO) availability, and exhaustion are likely linked to maximal fat oxidation, due to alterations in substrate availability. The contribution of these external factors to alterations in substrate utilization is, as of yet, unknown

Study objective

We aim to establish the impact of pre-exercise CHO availability and exhaustion on maximal fat oxidation (MFO & FATmax) during exercise

Study design

The study consist of two parts. In part I the impact of carbohydrate availability will be assessed, in part II the impact of exhaustion. Both parts have a cross-over design.

In part I subjects will perform an graded exercise test to measure maximal fat oxidation ('fatmax test'). At one occasion with low CHO, the other time with high CHO. The order will be randomised. One week will be considered in between conditions.

In part II, subjects will do the graded exercise test twice on a single day, but now with an exhaustive exercise session ('training') of ~ 90 min in between, to induce exhaustion

In both parts, the experimental testing will be preceded by a visit in which body composition is measured and subjects are familiarised to the test procedures. In addition, a physical activity questionnaire and a 3 day food

record will be taken.

The graded exercise test is the so-called *fatmax test* as described by Achten and Jeukendrup (2003). Participants start with a warming up at 95W (males) or 60 W (females), after which intensity will be increased every 3 min with 35 W, till exhaustion. Heart rate as well as oxygen consumption (VO2) and carbon dioxide production (VCO2) will be monitored, to obtain fat oxidation rates and maximal aerobic capacity.

Intervention

Part I: In this part of the study the pre-exercise availability of carbohydrates will be manipulated. Before measuring maximal fat oxidation during exercise, subjects will be randomly-assigned to a 36 hour period (i.e an afternoon, a single day plus a breakfast) of either a low CHO / high fat diet (~65 %en by fat) or an equal energy (isocaloric), high carbohydrate diet (~65 %en by CHO).

Part II: in this part the intervention is a 'training session' of 90 min at 60% Wmax, with every 15 min a high intensity bout of exercise of 2 min (90%Wmax). This is to simulate a training session, and induce exhaustion.

The day before the trials, participants have to refrain from exercise

Study burden and risks

The burden associated with participation is as follows:
- the time investment that is required
- The exercise testing/ sessions
- The general rules and guidlines the participants need to obey
- Short term dietary manipulation (part 1)
- X-ray exposure during the DEXA-scan (the amount of radiation which the participant is exposed to is negligible)

The exercise sessions can induce fatigue and muscle soreness. Muscle soreness will generally resolve in days. Exercise sessions will be done in the exercise lab of the Health Research unit of WUR, with adequate medical back-up. Participants are healthy

The dietary manipulation might cause some discomfort. Especially the low carbohydrate diet might be burdensome for the participants, as this nutritional pattern is not something the participants are used to. The participants are required to follow an altered dietary pattern twice, each for a period approx. 36 hours. This can considered to be a burden for the participant.

The participants will visit the research facility for a maximum of four times

during the study. Total duration of the visits will be 8-9 hours in a period of 2-3 weeks.

Contacts

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Trial sites

Listed location countries

Netherlands

Eligibility criteria

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

Inclusion criteria

* Apparently healthy (self-reported)
* aged between 20 and 35
* BMI between 18.5 to 27 kg/m2
* Recreationally active, defined as minimal of 3 hours training per week, and a maximum of 10 hours a week
* The sport a participant is engaged in should be a game sport, endurance sport, or should at least contain a major endurance component. Examples of sports that can be included are: distance running, cycling, triathlon,

crossfit, and game sports like soccer, rugby, handball, hockey,
* For part 2 subjects should be used to prolonged cycling exercise
* Able to be present and participate at all test days and willing and able to follow prescribed interventions

Exclusion criteria

* Inactive (defined as <3 hours of training per week)
* Non-recreational athlete (>10 hours of training per week)
* active in a sport without a major endurance component
* Smokers, defined as someone who has smoked regularly in the previous year.
* Excessive alcohol consumption (i.e. more than 14 units for males per week; 7 units for females)
* Drug use
* The more *extreme* diets (like veganism, ketogenic diet, raw-food, carnivore diet etc.)
* Participation in another biomedical study possibly interfering with the study results within 1 month before the first study visit
* Inability to participate and/or complete the required measurements
* People working for the department of Human Nutrition and Health not having a GP

Study design

Design

Study type:	Interventional
Intervention model:	Crossover
Allocation:	Randomized controlled trial
Masking:	Open (masking not used)
Control:	Active
Primary purpose:	Basic science

Recruitment

NL

Recruitment status:	Recruitment stopped
Start date (anticipated):	26-10-2020
Enrollment:	40

Type:	Actual

Ethics review

Approved WMO Date:	14-09-2020
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
ClinicalTrials.gov	NCT
CCMO	NL72841.081.20