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Effect of varying carbohydrate and fat intake on endurance athlete performance and health

Submission date
24/06/2016

Recruitment status
No longer recruiting

Registration date
10/08/2016

Overall study status
Completed

Last Edited
12/09/2023

Condition category
Nutritional, Metabolic, Endocrine

[_] Prospectively registered
[_] Protocol
[_] Statistical analysis plan
[X] Results
[_] Individual participant data

Plain English summary of protocol

Background and study aims
Traditionally, diets high in carbohydrates are recommended to enhance the performance of endurance athletes, however when an athlete runs out of carbohydrates they end up "hitting the wall" and unable to continue. A possible alternative energy source is fat, which has higher energy content per gram, meaning it is able to provide much more energy than carbohydrate. Unfortunately fat cannot efficiently be used for energy unless carbohydrates are restricted. Previous research has not categorically proven whether performance is enhanced or reduced on a high fat diet since the studies did not last for long enough for the body to adapt to the new diets and carbohydrate levels were still too high. This study aims to examine the effect of a high fat, low carbohydrate diet versus a high carbohydrate diet on endurance athlete performance and health. It is also possible that increasing the fatty acid content of the high fat diet using supplements could have additional benefits on fat oxidation and endurance performance. High carbohydrate diets have recently received a lot of notice in terms of having negative effects on health; however it is not known whether similar effects are experienced in athletes. Therefore health factors associated with consuming a high fat/low carbohydrate diet or a high carbohydrate diet over 12 weeks, will also be examined.

Who can participate?
Healthy adult male endurance athletes who train more than seven hours a week.

What does the study involve?
At the start of the study, all participants record what they eat for three days in a diary so their current nutritional intake can be analysed. In addition, participants have their weight and height measured, followed by a body scan to measure their fat, muscle and bone content. They then have a blood sample taken and have their best time cycling 100km (on a cycle machine). Participants are then allocated to one of three groups. Those in the first group eat a high carbohydrate diet for 12 weeks, in which most of their energy is coming from carbohydrates. Those in the second group eat a low carbohydrate, high fat diet for 12 weeks, in which most of their energy is coming from fat. Those in the third group each a low carbohydrate diet and also take supplements containing polyunsaturated fat, from which they get most of their energy from, for 12 weeks. After six and 12 weeks, all participants have their body composition measured again and blood samples are taken to measure their general health.

What are the possible benefits and risks of participating?
Participants benefit from receiving a complete analysis of their diet and information about their body composition (fat, muscle and bone content) and general health. There is a risk of low energy levels for participants on the low carbohydrate diets at first, as it takes a while for the body and brain to get used to using fat as a source of energy instead of carbohydrate. As such it is advised the athlete complete minimal training during the first 2 weeks of the new diets. There is also a risk of bruising, pain or infection from the blood testing.

Where is the study run from?
Waterford Institute of Technology (Ireland)

When is the study starting and how long is it expected to run for?
October 2014 to August 2017

Who is funding the study?
Waterford Institute of Technology (Ireland)

Who is the main contact?
Dr Lorna Doyle

Contact information

Type(s)
Scientific

Contact name
Dr Lorna Doyle

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Additional identifiers

EudraCT/CTIS number

IRAS number

ClinicalTrials.gov number

Secondary identifying numbers
N/A

Study information

Scientific Title
Effect of a 12 week low carbohydrate, high fat, high carbohydrate or low carbohydrate diet supplemented with polyunsaturated fats on endurance athletes performance and health markers

Study objectives
1. Once adapted to a low carbohydrate (ketogenic) diet and with appropriate training, an endurance athlete can perform as well if not better than an endurance athlete adhering to a high carbohydrate diet
2. An athlete consuming a high fat diet with polyunsaturated fats (including medium chain triglycerides) will have better performance and health benefits than those consuming a high fat diet with greater level of saturated fat

Ethics approval required
Old ethics approval format

Ethics approval(s)
Waterford Institute of Technology Ethics Committee, 04/03/2015, ref: 15/HSES/03

Approval for addition of the polyunsaturated fatty acid to the low carbohydrate diet.
Waterford Institute of Technology Ethics Committee, 11/04/2016, ref: 16/HSES/01

Study design
Single-centre non-randomised parallel group trial

Primary study design
Interventional

Secondary study design
Randomised parallel trial

Study setting(s)
Other

Study type(s)
Other

Participant information sheet
Not available in web format, please use the contact details below to request a patient information sheet

Health condition(s) or problem(s) studied
Sports performance, fuel utilization and health (haematological, cardiovascular, inflammation and bone health)

Interventions
Participants are allocated into one of three study arms, depending on which group they would be able to adhere to.

Group 1: Participants follow a low carbohydrate diet, which involves provision of at least 70% kcal from fat, 20% kcal from protein and <50g/d carbohydrate
Group 2: Participants follow a high carbohydrate diet, which involves aiming to consume >5g carbohydrate/kg body weight per day and continue to maintain energy intake.
Group 3: Low carbohydrate supplemented with polyunsaturated fat. This involves adherence to a diet with <50/d carbohydrate, 15-20% kcal from protein with the remainder of the diet's calories coming from fat which includes consumption of 1 tablespoon Udo's oil/d per 50lb body weight. Daily oil consumption may be incorporated within recipes.

Each diet is consumed for a period of 12 weeks in conjunction with an exercise training programme, consisting of high intensity interval training (HITT) and strength training, in addition to continuing to take part in endurance training for at least 7 hours/week.

Participants are followed up at 12 weeks. Performance is measured through a 100km time trial and critical power test. Blood lactate is measured at 20km intervals. Respiratory exchange ratio (RER) is measured throughout the 100km time trial. Blood samples are analyzed using the haematology analyzer and analyzed for markers of inflammation, bone biomarkers and cardiovascular health (serum cholesterol, LDL, VLDL and HDL) at weeks 0 and 12.

Intervention Type
Other

Primary outcome measure
1. Nutritional intake (dietary fat, carbohydrate and protein) is measured using the nutritics dietary analysis programme at baseline and 12 weeks
2. Fuel utilization measured through respiratory exchange ratio (RER) using the moxus, was recorded at baseline and 12 weeks
3. Critical power is measured through a 100km time trial on a cycle ergometer at baseline and 12 weeks
4. Blood lactate is measured using lactatepro and was taken at the start of the time trial and every 20km during the time trials undertaken, at baseline and 12 weeks

Secondary outcome measures
1. Body composition (fat and muscle mass) is measured using a DXA scanner at baseline and 12 weeks
2. Bone density and mass is measured using a DXA scanner at baseline and 12 weeks
3. Blood cholesterol is measured using the randox method at baseline and 12 weeks
4. Serum C reactive protein is measured through ELISA at baseline and 12 weeks
5. Hematology of blood is measured using a hematology analyser at baseline and 12 weeks

Overall study start date
01/10/2014

Completion date
01/08/2017

Eligibility

Key inclusion criteria

1. Male
2. Age 18-40 years
3. Endurance athlete for past 12 months completing minimum 7hrs/week training

Participant type(s)
Healthy volunteer

Age group
Adult

Lower age limit
18 Years

Upper age limit
40 Years

Sex
Male

Target number of participants
30 total, 10 in each group

Total final enrolment
20

Key exclusion criteria
1. Not an endurance athlete
2. Already consuming a low carbohydrate high fat diet
3. Unable to complete a 100km time trial
4. Any health conditions such as heart problems, blood pressure
5. Disorders related to enzyme production

Date of first enrolment
01/03/2015

Date of final enrolment
01/06/2017

Locations

Countries of recruitment
Ireland

Study participating centre
Nutrition Research Centre Ireland
Dept. Health, Sport and Exercise
School of Health Sciences
Waterford Institute of Technology

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Sponsor information

Organisation
Waterford Institute of Technology

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Sponsor type
University/education

Website
https://www.wit.ie/

Funder(s)

Funder type
University/education

Funder Name
Waterford Institute of Technology

Results and Publications

Publication and dissemination plan
Planned publication in a high-impact peer reviewed journal.

Intention to publish date
30/06/2018

Individual participant data (IPD) sharing plan

IPD sharing plan summary

Available on request

Study outputs

Output type	Details	Date created	Date added	Peer reviewed?	Patient-facing?
Results article	results	01/04/2018	05/08/2019	Yes	No
Results article		30/08/2019	12/09/2023	Yes	No