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Monitoring and treatment of obesity-related sleep disorders

Submission date
12/10/2012

Recruitment status
No longer recruiting

Registration date
23/10/2012

Overall study status
Completed

Last Edited
19/02/2021

Condition category
Nervous System Diseases

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

Plain English summary of protocol

Background and study aims
Obesity is a major risk factor for sleeping disorders such as obstructive sleep apnea (OSA), where the walls of the throat relax and narrow during sleep, interrupting normal breathing and sleep. Current common treatments for obesity-related sleeping disorders do not completely cure the symptoms. Thus, there is an urgent need for alternative ways to treat obesity-related sleep disorders. The aim of this study is to find out whether exercise or diet changes can improve the quality of sleep of people with obesity-related sleeping disorders. Furthermore, we will examine the effects of exercise or diet on the gut microbiota (microbes in the gut), to help us understand the underlying mechanisms of obesity and sleep disorders.

Who can participate?
Men aged 30-65 with mild to moderate OSA or reporting poor quality of sleep, and also healthy volunteers with no sleep disorders

What does the study involve?
Participants are randomly allocated to one of three groups: exercise, diet and control. For the exercise group, participants undertake an aerobic exercise program created individually on the basis of their initial fitness level and modified monthly during the study. Aerobic exercises are performed 3-5 times per week, 20-60 minutes each time under the guidance of an exercise instructor and monitored by a wrist computer. The diet group receive diet counseling from a dietitian weekly for the first month and monthly thereafter, and upload photos of their meals to an internet service 1-5 times a week during the study. The control group are asked to continue their normal activities and diet. Measurements are performed at the start of the study and at 3- and 6-month follow-ups. After the end of the study the control group continues for an additional 3 months with the same exercise and diet intervention the other groups did. The assessments include questionnaires on health, sleep, physical activity and diet, sleep quality measurements, body composition, fitness tests, blood sample for determining hormones and biochemical markers, fecal sample for determining gut microbiota, and adipose tissue sample for analyzing fat metabolism.

What are the possible benefits and risks of participating?
The study may help subjects to improve their quality of sleep and general health. There are not any significant risks in taking part in this study.

Where is the study run from?
University of Jyvaskyla (Finland)

When is the study starting and how long is it expected to run for?
April 2011 to December 2013

Who is funding the study?
Finnish Funding Agency for Technology and Innovation (Finland)

Who is the main contact?
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Contact information

Type(s)
Scientific

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Additional identifiers

Protocol serial number
TEKES 2206/31/2010

Study information

Scientific Title
Effects of exercise and diet interventions on obesity-related sleep disorders: a randomized controlled trial in men

Acronym
MOTOSD

Study objectives

Current study hypothesis as of 25/03/2013:
1. Physical activity is beneficial in terms of good quality and proper duration of sleep. The levels of melatonin, cortisol, and neuro-active steroids are modified by physical activity and thereby influence sleep.
2. The amount of micronutrients in the diet, such as tryptophan and vitamin Bs, are correlated with quality and duration of sleep.
3. Six-month guided individualized exercise or diet counseling intervention can independently alleviate sleep disorders among adult men with sleep disorders. The improvement can be observed by changes in duration of total sleep, duration and proportion of slow-wave sleep (SWS) and rapid-eye-movement (REM) sleep, stress reactions based on heart rate variability (HRV), AHI (participants with OSA), as well as subjective sleep measures such as Epworth Sleepiness Scale score.
4. Prolonged good quality of sleep after six-month individualized exercise intervention is linked to increased oxidative stress that in turn may affect melatonin levels in the peripheral circulation because indole is rapidly used to combat free radical damage. Exercise also affects cortisol and neuro-active steroid levels. The mutual interactions between exercise and these hormone milieus are responsible for sleep-wake cycle regulation.
5. Six-month guided individualized diet counseling intervention can improve sleep quality through modification of gut microbiota composition. The composition of the gut microbial community is host specific, evolving throughout an individuals lifetime and susceptible to both exogenous and endogenous modifications. Hence, the cross-talk between gut hormones and hypothalamic factors (gut-brain axis) is important in the regulation of food intake and sleeping disorders.

Previous study hypothesis until 25/02/2013:
1. Guided individualized exercise or diet program can independently improve the quality of sleep among men with sleep disorders. The improvement can be observed by both objective and subjective measures of quality of sleep.
2. Guided individualized exercise or diet program has significant effects on glucose and lipid metabolism as well as the composition of gut microbiota, therefore improving the quality of sleep. The cross-talk between gut hormones and hypothalamic factors (gut-brain axis) is the underlying mechanism in the regulation of food intake and sleep disorders. The re-patterning of gut microbiota composition is accompanied by optimization of body composition, which can affect the neurochemistry of sleep and thus address root causes of sleep disorders.

Ethics approval required
Old ethics approval format

Ethics approval(s)
Ethics Committee of the Health Care District of Central Finland, 28/04/2011

Study design
Randomized interventional trial

Primary study design
Interventional

Study type(s)
Treatment

Health condition(s) or problem(s) studied

Sleep disorders, Insomnia, Obstructive sleep apnoea

Interventions
6-month exercise or diet intervention is involved in this study.

Exercise program
Based on the fitness test result an individual progressive exercise program is created according to the recommendations of ACSM (American College of Sports Medicine). This program is downloaded to a wrist computer and the subjects exercise independently following the guidance by the wrist computer. Exercise events are selected by the subject himself. The exercise is performed 3 to 5 times per week 20 to 60 minutes per time at the level of 60 to 75% of the maximum heart rate. Once a week, the subjects have the opportunity to attend supervised exercise sessions (Nordic walking, strengthening exercises, stretching, relaxation). Instructions for stretching and recovery during exercise are given to all members in exercise group. Web service (Movescount by SuuntoOy) is used to monitor the exercise adherence. Participants transfer the data on their exercise sessions from wrist computer to the service every two weeks.

Diet counseling
Specific individualized dietary programs are developed after baseline assessments on the basis of each individuals current dietary intakes and body mass index. The diet contains energy of 40% carbohydrate with < 5 % sucrose, 40% fat (SAFA 10%, MUFA 15-20%, PUFA 10%) and 20% protein and is rich in several vitamins and micronutrients. Overweight/obese subjects are advised to moderately reduce their total energy intake (300-500 kcal per day for the first 3 months) with guidance of the proportion of macronutrients. Subjects with normal weight are advised to maintain their body weight. Furthermore, an internet service (MealTracker) is involved to provide nutritional counseling for the participants. The subjects send information about their meals by photos taken with their mobile phone camera 2-3 days a week. A nutritionist gives feedback via text messages or e-mail. In addition to information on their food intake, the subjects send regularly information on their weight online.

Intervention Type
Behavioural

Primary outcome(s)
Current primary outcome measures as of 25/02/2013:
1. Duration and proportion of sleep stages, heart rate, heart rate variability, respiration and body movements during sleep apnea-hypopnea index [PSG for participants with OSA, Pressure sensor measurement for both OSA and other participants]
2. Subjective measures of duration and quality of sleep (Nordic sleep disorder questionnaire, Epworth Sleepiness Scale, 7-day sleep diary)
3. Lifestyle risk clusters related to sleep disorders (healthy vs. sleep disorder patients)

Previous primary outcome measures until 25/02/2013:
1. Subjective quality of sleep (sleep questionnaires including Nordic sleep questionnaire and Epworth Sleepiness Scale, 7-day sleep diary)
2. Sleep architecture, Heart rate, Heart rate variability, Respiratory and Body movements during sleep (polysomnography for subjects with sleep apnea, pressure sensors for subjects with sleep apnea and poor quality of sleep)
3. Both measurements are taken at baseline and after 6-month intervention. In addition, subjective quality of sleep is collected at 3-month.

Key secondary outcome(s))
Current secondary outcome measures as of 25/02/2013:
1. Anthropometry (Body weight and height; Waist, Hip, Chest and Neck circumferences)
2. Blood pressure
3. Body composition (Dual-energy x-ray absorptiometry and Bioimpedance)
4. Fitness (2 km walking test, three-minute step test)
5. Composition of the gut microbes (fecal sample)
6. Subcutaneous adipose tissue metabolism (total RNA)
7. Venous blood samples (total cholesterol, HDL-cholesterol, LDL-cholesterol, triglycerides, glucose, insulin, histamine, tryptophan, melatonin, cortisol, adrenalin, leptin, adiponectin, neuroactive steroids, fatty acid, B vitamins, fatty acid profile, as well as inflammatory variables such as CRP, IL-6, and TNF-alpha).

Previous secondary outcome measures until 25/02/2013:
1. Venous blood samples (total cholesterol, HDL-cholesterol, triglycerides, LDL-cholesterol, apolipoproteins A-I and B, lipoprotein(a), glucose, insulin, melatonin, serotonin, cortisol, adrenin, leptin, adiponectin, fatty acid profile as well as inflammatory variables i.e., C-reactive protein, TNF and IL-6, etc.)
2. Blood pressure
3. Body composition (dual-energy x-ray absorptiometry and bioimpedance)
4. Anthropometry (body weight; waist, hip, chest and neck circumference)
5. Fitness (2 km walking test, 3 minute step test)
6. Physical activity (3 day diary)
7. Diet (3 day diary)
8. Fecal samples (composition of the gut microbes)
9. Subcutaneous adipose tissue samples (total RNA, reverse transcription reaction followed by real-time PCR with gene-specific primer sequences)
10. Measurements are taken at baseline, 3-month and after 6-month intervention

Completion date
31/12/2013

Eligibility

Key inclusion criteria
Current inclusion criteria as of 25/02/2013:
Apnea and insomnia patient groups:
1. Men in an age range of 30 to 65 years
2. Occasionally physically active or sedentary (regular leisure-time exercise ≤ 2 times/wk & ≤ 45 min/time)
3. Reports recurrent difficulty in falling asleep, too short sleep duration or poor quality of sleep during past 2 months. Or with mild to moderate OSA (AHI 5-30 / hour), with or without continuous positive airway pressure (CPAP) treatment. If under treatment, nasal CPAP for a minimum period of 6 months prior the baseline measurements, with a minimum adherence to CPAP therapy for 4 hours per night
4. Relatively healthy (free from cardiovascular comorbidities)

Reference (healthy men) group:
1. Men in an age range of 30 to 65 years

2. No chronic sleep disorders and medications related to sleep disorders
3. No disease and medications during past 1 year
4. Relatively healthy (free from cardiovascular comorbidities)

Previous inclusion criteria until 25/02/2013:
1. Males with an age range of 30 to 65 years
2. Occasionally physically active or sedentary (regular exercise ≤ 2 times/wk& ≤ 45 min/time)
3. Reported recurrent difficulty in falling asleep, too short sleep time or poor quality of sleep during past 2 months, or diagnosed with Mild to moderate obstructive sleep apnea (AHI 5-30 / hour), with or without CPAP treatment. If under treatment, nasal CPAP for a minimum period of 6 months, with a minimum adherence to CPAP therapy for 4 hours per night.
4. Relatively healthy (free from cardiovascular comorbidities)

Participant type(s)
Patient

Healthy volunteers allowed
No

Age group
Adult

Sex
Male

Total final enrolment
45

Key exclusion criteria
Current exclusion criteria as of 25/02/2013:
1. Diseases and medications related to insulin dependent diabetes mellitus, Crohns disease, sarcoidosis, celiac disease, thyroid, liver and severe heart diseases, chronic diarrhea, ulcerative colitis, rheumatoid arthritis, severe osteoarthritis, systemic lupus erythematous, cancer during past 3 years.
2. Currently taking special diet (such as very low calorie diet)
3. Other diagnosed sleep disorders (such as narcolepsy)
4. Shift workers (working during night)
5. Reported cognitive impairment
6. Using antibiotics during the previous 3 months
7. History of eating disorders
8. Subjects using CPAP, professional drivers and other professions that are at risk for accident due to discontinuation in CPAP treatment
9. Not suitable for the study by a physicians evaluation

Previous exclusion criteria until 25/02/2013:
1. Diseases and medications related to insulin dependent diabetes mellitus, Crohns disease, sarcoidosis, celiac disease, thyroid, liver and severe heart diseases, chronic diarrhea, ulcerative colitis, rheumatoid arthritis, severe osteoarthritis, systemic lupus erythematous, cancer during past 3 years.
2. Diet with very low calorie (VLCD)
3. Other sleep disorders e.g. narcolepsy

4. Shift workers (working during night)
5. Reported cognitive impairment
6. Using antibiotics during the previous 3 months
7. History of eating disorders
8. In patients under CPAP treatment, professional drivers and other professions that are at risk for accident due to discontinuation of CPAP treatment
9. Not suitable for the study by a physicians evaluation

Date of first enrolment
28/04/2011

Date of final enrolment
31/12/2013

Locations

Countries of recruitment
Finland

Study participating centre
University of Jyvaskyla
Jyvaskyla
Finland
40014

Sponsor information

Organisation
Finnish Funding Agency for Technology and Innovation (TEKES)

Funder(s)

Funder type
Government

Funder Name
Tekes

Alternative Name(s)
Finnish Funding Agency for Innovation

Funding Body Type

Government organisation

Funding Body Subtype
Local government

Location
Finland

Results and Publications

Individual participant data (IPD) sharing plan

IPD sharing plan summary
Not provided at time of registration

Study outputs

Output type	Details	Date created	Date added	Peer reviewed?	Patient-facing?
Results article	results	01/09/2016	19/02/2021	Yes	No
Protocol article	protocol	26/07/2013		Yes	No