

# Effects of a 12-week exercise program and a lifestyle app on sleep-disordered breathing in adults

<b>Submission date</b> 16/01/2023	<b>Recruitment status</b> No longer recruiting	<input type="checkbox"/> Prospectively registered <input type="checkbox"/> Protocol
<b>Registration date</b> 09/02/2023	<b>Overall study status</b> Completed	<input type="checkbox"/> Statistical analysis plan <input checked="" type="checkbox"/> Results
<b>Last Edited</b> 27/08/2025	<b>Condition category</b> Nervous System Diseases	<input type="checkbox"/> Individual participant data

## Plain English summary of protocol

### Background and study aims

Sleep-disordered breathing (SDB) is a term that covers breathing problems during sleep, such as snoring and obstructive sleep apnea (OSA). OSA is a serious condition that affects one billion people between 30 and 69 years old and can lead to decreased sleep quality and quantity, weight gain, and other health problems such as cardiovascular disease, metabolic syndrome, and decreased daily functioning. Obesity is the main risk factor for SDB, with over 70% of people with OSA being considered obese. Exercise is a well-known treatment for obesity and has been shown to have positive effects on sleep disorders like OSA, by improving sleep quality, exercise capacity, mood and quality of life, and decreasing OSA symptoms. Studies have shown that exercise interventions of up to 12 weeks have significant improvements in OSA symptoms. Regular exercise alone, without significant weight loss, can also reduce the severity of symptoms in OSA patients.

### Who can participate?

Patients aged 18 - 50 years with mild to moderate sleep-disordered breathing

### What does the study involve?

Participants are randomly allocated to one of three groups.

Experimental group I undergoes an exercise program. The intervention will last 12 weeks with an exercise program of three 60-minute sessions per week. The exercise program consists of multiple stations (circuit training) with a fixed Work/Rest time, and brisk intensity walking for 8-14 minutes. All the sessions start with a ten-minute dynamic warm-up and end with a 10-minute cool-down and static stretches. The practice equipment used in the interventions consists of resistance bands, free weights, aerobic steppers, medicine balls, Bosu balls, and exercise mats. The exercise program follows the general recommendation for exercise programs in SDB patients. The trainer coach will follow these recommendations under the supervision of a Sports Science and Exercise specialist. This trainer coach will monitor the intensity using the Borg scale of perceived exertion, which will be between 13 and 15 in the main part (circuit training and brisk walking) and between 7 and 11 in the warm-up and cool-down.

Experimental group II uses a lifestyle app from SideKick Health (SKH) developed specifically for

this group of subjects. The lifestyle app consists of daily missions with four main pillars: physical activity, relaxation, nutrition and sleep, which are made attractive through gamification and rewards. The daily tasks keep the patients focused on their goal of improving their health through diet and exercise, and the gamification of the intervention will help keep participants motivated and engaged. The Sidekick intervention for lifestyle modification provides a combination of a complete, individualized intervention with feedback (through the platform) from a live coach.

The control group receives treatment as usual.

What are the possible benefits and risks of participating?

The potential benefit would be to reduce the severity of sleep-disordered breathing. The participants in the experimental groups will benefit from an intervention led by researchers in the field of exercise programs and the use of apps with the intention of improving sleep-disordered breathing. Participants in the control group will benefit from knowing their baseline of the parameters studied. There are no special risks.

Where is the study run from?

Reykjavik University (Iceland)

When is the study starting and how long is it expected to run for?

January 2021 to December 2023

Who is funding the study?

European Union Horizon 2020 research and innovation programme under grant agreement no. 965417

Who is the main contact?

Dr Erna Sif Arnardóttir, ernasifa@ru.is

## Contact information

### Type(s)

Principal investigator

### Contact name

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## Additional identifiers

## **Clinical Trials Information System (CTIS)**

Nil known

## **ClinicalTrials.gov (NCT)**

Nil known

## **Protocol serial number**

European Union's Horizon 2020 research and innovation programme under grant agreement no. 965417

# **Study information**

## **Scientific Title**

Effects of an exercise program and a lifestyle app on sleep parameters, body composition, physical fitness and neurocognitive function in overweight and obese patients (aged 18-50 years) diagnostic of mild sleep disorders of breathing

## **Study objectives**

An exercise program and lifestyle app achieve improvements in sleep-disordered breathing symptoms in overweight and obese patients.

## **Ethics approval required**

Old ethics approval format

## **Ethics approval(s)**

Approved 10/05/2022, Icelandic national bioethics committee (Vísindasiðanefnd, Borgartúni 21 – 4 floor, 105 Reykjavik, Iceland; +354 551-7100; vsn@vsn.is), ref: VSN-22-082

## **Study design**

Interventional randomized controlled trial

## **Primary study design**

Interventional

## **Study type(s)**

Treatment

## **Health condition(s) or problem(s) studied**

Improvement of sleep-disordered breathing in patients with sleep apnea

## **Interventions**

The participants were randomly assigned to a group using a randomization algorithm. Using a hierarchical structure, the algorithm prioritized balancing the female and male count across the three groups (control, exercise, app). The algorithm then calculated a "score" for each group. The "score" reflected the difference between the average value and standard deviation of key variables in each group to the total sample, total female sample, and total male sample. When gender distribution was not a determining factor, the algorithm used the "score" to balance each group with regard to the overall sample characteristics (total, females, males). The

variables used included the apnoea-hypopnea index, body mass index, and age. These variables were chosen due to their potential confounding effects on the study outcomes. The algorithm was built and run using Python version 3.10.6.

#### **Experimental group I**

**Exercise program.** The intervention will last 12 weeks with an exercise program of three 60-minute sessions per week. The exercise program consists of multiple stations (circuit training) with a fixed Work/Rest time, and brisk intensity walking for 8-14 minutes. All the sessions start with a ten-minute dynamic warm-up and end with a 10-minute cool-down and static stretches. The practice equipment used in the interventions consists of resistance bands, free weights, aerobic steppers, medicine balls, Bosu balls, and exercise mats. The exercise program follows the general recommendation for exercise programs in SDB patients. The trainer coach will follow these recommendations under the supervision of a Sports Science and Exercise specialist. This trainer coach will monitor the intensity using the Borg scale of perceived exertion, which will be between 13 and 15 in the main part (circuit training and brisk walking) and between 7 and 11 in the warm-up and cool-down.

Electronic sleep diary with standardized feedback through the Sleep Revolution mobile application and continuous monitoring of heart rate, activity monitoring, and SpO2 with Withings ScanWatch for 12 weeks.

#### **Experimental group II**

##### **Sidekick health group**

The lifestyle app used is from SideKick Health (SKH) and was developed specifically for this group of subjects. The lifestyle app consists of daily missions with four main pillars: physical activity, relaxation, nutrition and sleep, which are made attractive through gamification and rewards. The daily tasks keep the patients focused on their goal of improving their health through diet and exercise, and the gamification of the intervention will help keep participants motivated and engaged.

The Sidekick intervention for lifestyle modification provides a combination of a complete, individualized intervention with feedback (through the platform) from a live coach.

#### **Control group**

Treatment as usual.

Electronic sleep diary with standardized feedback through the Sleep Revolution mobile application and continuous monitoring of heart rate, activity monitoring, and SpO2 with Withings ScanWatch for 12 weeks.

### **Intervention Type**

Behavioural

### **Primary outcome(s)**

SDB severity is measured with a three-night sleep study, using self-applied somnography (SAS) from NOX Medical (Reykjavik, Iceland) at baseline and follow-up (12 weeks).

### **Key secondary outcome(s)**

1. Sleep quality measured objectively with SAS and subjectively with a sleep diary. Objective measures of sleep quality at baseline and 12-week follow-up. Subjective measures of sleep quality daily for the 12-week intervention.
2. Body composition at baseline and 12-week follow-up:

- 2.1. Body mass index. BMI is a person's weight in kilograms divided by the square of height in meters.
- 2.2. Body fat percentage. Bioelectrical impedance analysis (BIA) will be used to estimate body composition. In BIA, a weak electric current flows through the body and the voltage is measured in order to calculate the impedance (resistance) of the body. The equipment used will be the Bodystat 500 (Isle of Man, UK). It uses 4 electrodes (ankle and wrist) to measure raw data at any segment of the body. Waist-hip ratio. The waist-to-hip ratio is the ratio of waist circumference to hip circumference, a simple calculation of the measurements of the waist girth divided by the hip girth.
3. Physical fitness at baseline and 12-week follow up:
  - 3.1. Strength. Hand dynamometry of the dominant hand will be evaluated with a Vernier hand dynamometer (Vernier, Orlando, FL, USA), with the subject seated and the elbow at 90°.
  - 3.2. Cardiorespiratory endurance. The 6-Minute Walking Test is a sub-maximal self-paced test that measures the individual's sub-maximal capacity to perform activities. The 6-Minute Walking Test measures how far an individual can walk when walking as fast as he/she possibly can in a period of six minutes on a hard and flat surface. The 6-Minute Walking Test is performed indoors on a walking course of 30 meters (60-meter lap).
4. Physiological parameters measured via Withing smartwatch (including SaO2 measurements for SDB severity estimation, movements and pulse) continuously for the 12-week intervention.
5. Neurocognitive function measured using the Rey Auditory Verbal Learning Test (RAVL-T) wordlists, the Wechsler Memory Scale, the Verbal Fluency Test, Digit span, Trail making test, at baseline and 12-week follow-up.

### **Completion date**

31/12/2023

## **Eligibility**

### **Key inclusion criteria**

1. Signed, informed, written consent
2. Age 18 - 50 years
3. Verified mild to moderate sleep-disordered-breathing according to the current American Academy of Sleep Medicine and International Classification of Sleep Disorders criteria
4. The SDB level may range from habitual snoring to positional and mild obstructive sleep apnea, not fulfilling the criteria for continuous positive airway pressure therapy treatment
5. BMI  $\geq 25$  kg/m<sup>2</sup> (overweight or obese)
6. Inactive person (no participation in exercise programs at baseline)
7. Subjects willing to try lifestyle change, including an exercise program
8. Willingness to perform the study-specific testing both at baseline and during follow-up
9. Ability to read, follow the lifestyle program and answer the questionnaires in DMP, electronic sleep diary and objective daytime testing (via DMP and physical visits)

### **Participant type(s)**

Patient

### **Healthy volunteers allowed**

No

### **Age group**

Mixed

**Sex**

All

**Total final enrolment**

200

**Key exclusion criteria**

1. Severe OSA
2. Inability to perform an exercise
3. Regular use of hypnotic medications
4. Clinically verified dominant central sleep apnea
5. Known history of active malignant disease
6. Blindness or hearing loss
7. Unstable cardiometabolic disease
8. Unstable psychiatric disease
9. Ongoing alcohol or drug abuse
10. Other medical conditions which may interfere with the study protocol in the opinion of the investigator

**Date of first enrolment**

01/08/2022

**Date of final enrolment**

31/12/2022

**Locations****Countries of recruitment**

Iceland

**Study participating centre**

Reykjavik University

Menntavegur 1

Reykjavik

Iceland

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**Sponsor information****Organisation**

Horizon 2020 - European Union

**Funder(s)**

**Funder type**  
Government

**Funder Name**  
Horizon 2020

**Alternative Name(s)**  
EU Framework Programme for Research and Innovation, Horizon 2020 - Research and Innovation Framework Programme, European Union Framework Programme for Research and Innovation

**Funding Body Type**  
Government organisation

**Funding Body Subtype**  
National government

**Location**

## Results and Publications

**Individual participant data (IPD) sharing plan**  
There will be no possibility of sharing individual participants' data

**IPD sharing plan summary**  
Not expected to be made available

### Study outputs

Output type	Details	Date created	Date added	Peer reviewed?	Patient-facing?
<a href="#">Results article</a>		23/06/2025	27/08/2025	Yes	No
<a href="#">Other publications</a>	Follow-on study	12/08/2025	27/08/2025	Yes	No
<a href="#">Participant information sheet</a>			09/02/2023	No	Yes
<a href="#">Participant information sheet</a>	Participant information sheet	11/11/2025	11/11/2025	No	Yes
<a href="#">Study website</a>	Study website	11/11/2025	11/11/2025	No	Yes