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Using nature-based exercise and inhalers to help people with chronic obstructive pulmonary disease get better

Submission date 30/10/2023	**Recruitment status** No longer recruiting	[ ] Prospectively registered [ ] Protocol [ ] Statistical analysis plan [ ] Results [ ] Individual participant data [ ] Record updated in last year
Registration date 04/12/2024	**Overall study status** Completed	
Last Edited 04/12/2024	**Condition category** Respiratory	

Plain English summary of protocol

Background and study aims
Chronic obstructive pulmonary disease (COPD) is a significant global health issue. Programs designed to help COPD patients recover, called pulmonary rehabilitation (PR), use a comprehensive approach to boost exercise capacity and alleviate symptoms like shortness of breath. They also aim to reduce anxiety, depression, and the frequency of disease flare-ups and hospital visits. However, the benefits of PR don't last forever. To ensure lasting improvements, patients must manage their health and adhere to their treatment plans, including adopting healthy habits. This study is a three-part scientific experiment to explore the potential short-term and long-term effects of two nature-based approaches – green exercise and aerosol inhalation at the Krimml waterfalls – in COPD rehabilitation. It will investigate how spending time in nature and using these interventions might impact the recovery of people with COPD.

Who can participate?
Patients with mild to moderate COPD, aged between 40 and 75 years old, with the physical capacity to move and perform light outdoor activities, who meet the inclusion criteria and do not meet the exclusion criteria.

What does the study involve?
Eligibility will be assessed during an examination before participation. Participants are divided into three different groups:

(a) One group will engage in a nature-based program and receive aerosol inhalation treatment.
(b) Another group will also participate in the nature-based program.
(c) The third group will stay at home and won't receive any special treatment (they're on a waiting list).

The first two groups will go on a 14-day health vacation in the alpine Hohe Tauern region in Pinzgau, located in the southwestern part of the Salzburg state in Austria. During this health

vacation, they will take part in an outdoor rehabilitation program. However, the aerosol intervention group will spend an additional hour each day at the Krimml waterfalls for aerosol inhalation, while the exercise intervention group won't receive any extra treatment.

The third group, the waiting list control group, will remain at home and will not get any special treatment. However, they will be asked to keep a record of their physical activity (how often and how long they exercise).

At the beginning of the study and three follow-up points, various factors will be measured to see how everyone is doing. These points are T1 (baseline/day 0), T2 (follow-up day 14), T3 (follow-up day 90), and T4 (follow-up day 180).

What are the possible benefits and risks of participating?
Possible benefits of participating: A vacation can improve mood and quality of life, but nature-based interventions may lead to yet unclear health benefits. Possible risks of participating: As a negative side effect of physical activity, exercise-induced bronchoconstriction may occur. Nature-based interventions may lead to yet unclear side effects.

Where is the study run from?
The Paracelsus Medical University (Austria)

When is the study starting and how long is it expected to run for?
January 2023 to September 2024

Who is funding the study?
This project was supported by the Science and Innovation Strategy 2025 of the Federal State Government of Salzburg, Austria (WISS 2025).

Who is the main contact?
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Contact information

Type(s)
Public, Scientific, Principal investigator

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Additional identifiers

Protocol serial number
v3.1_2023-08-09

Study information

Scientific Title
Green Exercise and Aerosol Inhalation for the Rehabilitation of COPD

Acronym
GEAR-COPD

Study objectives
In the present three-armed randomized controlled trial, the effects of two nature-based interventions (i.e., green exercise and aerosol inhalation at the Krimml waterfalls) compared to a non-intervention control condition will be investigated in a sample of patients with mild to moderate COPD deploying molecular, physiological and psychological methods.

Hypothesis I: A 14-day health vacation intervention with outdoor rehabilitation program positively affects the health state of patients with COPD compared to a stay-at-home waiting list control group of patients with COPD with regard to:
a) improvement of respiratory muscle strength
b) improvement of endurance performance or resilience
c) improvement of disease-related quality of life
d) reduction of COPD-associated inflammation in molecular parameters
e) improvement of general health parameters
f) improvement of cognitive performance
g) increase of training adherence and motivation.

Hypothesis II: The effects of the outdoor rehabilitation program(s) are more sustainable than those of the control condition.
a) Long-term changes can be measured until the follow-up time point day 90.
b) Long-term changes can be measured until the follow-up time point day 180.

Hypothesis III: The daily aerosol inhalation intervention leads to further health effects added to the effects of the outdoor rehabilitation program.
a) on a physiological level
b) on a psychological level
c) on a molecular level

Ethics approval required
Ethics approval required

Ethics approval(s)
Approved 26/04/2023, Ethics Committee for the State of Salzburg (Ethikkommission für das Bundesland Salzburg) (Sebastian-Stief-Gasse 2, Salzburg, 5020, Austria; +43 66280422401; ethikkommission@salzburg.gv.at), ref: 1057/2023

Primary study design

Interventional

Study design
Single-center randomized controlled intervention study with two parallel groups and a waiting control group at a 1:1 allocation outcome assessor blinded

Study type(s)
Quality of life, Treatment, Efficacy

Health condition(s) or problem(s) studied
Rehabilitation of patients with chronic obstructive pulmonary disease (COPD)

Interventions
Participants are randomly assigned to three study arms, i.e., two intervention groups (A: aerosol intervention, B: exercise intervention) and one waiting list control group. Randomization is done using an open-source add-in for Microsoft Excel. The following stratification factors should be considered: age, COPD severity and the distance achieved in the 6-Minute Walk Test (6MWT) as acquired during the baseline examination. The Kullback-Leibler divergence method will be used for allocation. A biometrician who is involved in the participant recruitment will perform randomization or stratification. Stratification factors are blind to the executing staff.

Both intervention groups spend a 14-day health vacation including an outdoor rehabilitation program. This outdoor rehabilitation program consists of the following components in both intervention groups:
- deflating breathing therapy
- thorax self-mobilization
- endurance training
- functional strength training
- relaxation exercises

Group A: The aerosol intervention group performs the deflating breathing therapy and the thorax self-mobilization regularly close to the Krimml waterfalls (Hohe Tauern Health Therapy Place, orographically right waterfall side).
Group B: The exercise intervention group stays at a control site and performs the same activities as group A. The aerobic endurance training takes place in the municipalities of Neukirchen and Bramberg.
Group C: The waiting list control group receives no direct intervention, however, is given general recommendations for a healthy lifestyle in the home environment (Personal consultation with a pulmonologist and an activity diary.

Program per study arm:
Group A: Aerosole intervention
a) General recommendations for a healthy lifestyle with COPD
b) Outdoor-based endurance training (walking, mountain hiking)
c) deflating breathing therapy
d) thorax self-mobilization
d) functional strength training
e) relaxation training
f) aerosol inhalation at the Krimml waterfalls

Group B: Exercise intervention
a) General recommendations for a healthy lifestyle with COPD
b) Outdoor-based endurance training (walking, mountain hiking)
c) deflating breathing therapy
d) thorax self-mobilization
d) functional strength training
e) relaxation training

Group C: No intervention
a) General recommendations for a healthy lifestyle with COPD
b) Activity diary

Intervention Type
Behavioural

Primary outcome(s)
Primary outcomes will be measured at four time points:
T1: baseline, day 0
T2: follow-up 1, day 14
T3: follow-up 2, day 90
T4: follow-up 3, day 180

1. Endurance performance is measured using the 6-Minute Walk Test (6MWT) at T1, T2, T3, and T4.
2. Disease-related quality of life is measured using the Saint George's Respiratory Questionnaire (SGRQ) at T1, T2, T3, and T4.
3. Respiratory muscle strength is measured using the spirometry parameters Maximum Inspiratory Pressure (MIP) and Maximum Expiratory Pressure (MEP) at T1, T2, T3, and T4.
4. Sympathetic activity at the waterfall or control site measured using tidal volume, and respiratory rate at T1 and T2 (short-term effects).

Key secondary outcome(s)
Secondary outcomes will be measured at four time points:
T1: baseline, day 0
T2: follow-up 1, day 14
T3: follow-up 2, day 90
T4: follow-up 3, day 180

1. Vital parameters
1a. Body composition measured using bioelectrical impedance analysis at T1, T2, T3, and T4.
1b. Body height and weight measured using scales at T1, T2, T3, and T4.
1c. Blood pressure measured using blood pressure monitors at T1, T2, T3, and T4.
1d. Oxigen saturation will be measured using near-infrared spectroscopy at T1, T2, T3, and T4.

2. Lung function paramters
2a. Forced Vital Capacity (FVC) and Forced Expiratory Volume in 1 second (FEV1) measured using spirometry at T1, T2, T3, and T4.
2b. Diffusion capacity (TLCO) measured using lung diffusion testing at T1, T2, T3, and T4.

3. Laboratory parameters
3a. Complete blood count and cytokines (e.g., IL-5, IL-10) in venous blood measured using Flow

Cytometry and immunoassay at T1, T2, T3, and T4.
3b. Immunoglobulin A in saliva samples measured using enzyme-linked immunoassay (ELISA) at T1, T2, T3, and T4.

4. Health-related quality of life measured using a survey at T1, T2, T3, and T4 including the following questionnaires:
4a. Short-Form-12
4b. EQ-5-DL
4c. WHO-5
4d. SF-36

5. Disease-related symptoms and quality of life measured using a survey at T1, T2, T3, and T4 including the following questionnaires:
5a. COPD Assessment Test (CAT)
5b. Clinical COPD Questionnaire (CCQ)
5c. Illness Cognition Questionnaire (ICQ)
5d. COPD Anxiety Questionnaire (CAF)
5e. Hospital Anxiety and Depression Scale (HADS)

6. Training motivation measured using a survey at T1, T2, T3, and T4 including the following questionnaires:
6a. Treatment-Self-Regulation (TSRS)

7. Cognitive performance measured using the Digit Symbol Substitution Test (DSST) at T1, T2, T3, and T4.

8. Training adherence in the follow-up phase measured using a survey at T1, T2, T3, and T4 including the following tools:
8a. A training diary with a protocol of training frequency and duration.
8b. Questionnaires on physical activity (e.g., International Physical Activity Questionnaire (IPAQ)

9. Subjective perception of secrete production and well-being measured using a survey at the waterfall and the control sites at T1 and T2 including the following tools:
9a. Goal Attainment Scale (GAT)
9b. Numeric Rating Scale (NRS)

10. Subjective perception of training intensity measured using a survey (e.g., training impulse according to Foster) at T1, and T2.

11. Breathlessness measured using a survey (z.B. BORG category ratio (CR-10) scale) at T1, and T2.

Additional measures:
Environmental parameters measured at the intervention sites where aerosol inhalation takes place and control places:
1. general environmental parameters: temperature, air pressure, humidity
2. fine dust concentration (pm10, pm2.5, pm1) measured using atmotube pro (atmotech inc.)
3. aerosol composition (particle size, mass, surface, etc.) measured using naneos partector
4. ion concentration: negatively and positively changed air ions measured using aic2 (alpha lab inc.)

Completion date

09/12/2024

Eligibility

Key inclusion criteria
1. Age 40 - 75 years
2. Diagnosis of mild to moderate, irreversible airway obstruction (Schirnhofer et al. 2007)
3. Pulmonary function values of FEV1/FVC < 0.70 showing COPD categorizable by GOLD severity 1-3 (30% ≤ FEV1 ≥ 80%)
4. General ability to walk and move (defined as >350m in the 6-Minute Walk Test)

Participant type(s)
Patient

Healthy volunteers allowed
No

Age group
Mixed

Lower age limit
40 Years

Upper age limit
75 Years

Sex
All

Key exclusion criteria
1. Acute counterindication
1.1. Acute exacerbation during the intervention period (T1-T2)
1.2. Optimization of pharmacotherapy < 3 weeks before the start of intervention (T1-T2)
2. Other counterindication or differential diagnosis
2.1. Aspergillosis
2.2. Alpha 1-antitrypsin deficiency
2.3. Severe lung disease under ongoing therapy (e.g., tumor)
2.4. Arteriosclerotic incident (e.g., myocardial infarction) < 1 year ago
3. Factors that hinder or do not allow participation in the training program:
3.1. < 350m on the 6-Minute Walk Test (Holland et al. 2014)
3.2. Uncorrectable visual or hearing impairment
3.3. Pregnancy > 1st trimester
4. Factors that hinder or do not allow self-management:
4.1. Cognitive impairment (Montreal Cognitive Assessment score < 26)
4.2. Moderate to severe depression (Becks Depression Inventory score > 19)
4.3. Alcohol or substance abuse (except for nicotine)
5. Participation in a pulmonary rehabilitation program (inpatient or outpatient) within the period of the clinical trial and less than 2 months before
6. Participation in another clinical trial within the clinical trial period and less than 4 weeks before

Date of first enrolment
26/04/2023

Date of final enrolment
31/10/2023

Locations

Countries of recruitment
Austria

Study participating centre
Paracelsus Medical University
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Sponsor information

Organisation
Paracelsus Medical University

ROR
https://ror.org/03z3mg085

Funder(s)

Funder type
Government

Funder Name
Salzburger Landesregierung

Alternative Name(s)
Federal State of Salzburg

Funding Body Type
Government organisation

Funding Body Subtype

Local government

Location
Austria

Results and Publications

Individual participant data (IPD) sharing plan
The data-sharing plans for the current study are unknown and will be made available at a later date

IPD sharing plan summary
Data sharing statement to be made available at a later date

Study outputs

Output type	Details	Date created	Date added	Peer reviewed?	Patient-facing?
Study website	Study website	11/11/2025	11/11/2025	No	Yes