The effect of indoor carbon dioxide on human cognition

No registrations found.

Ethical review	Positive opinion
Status	Recruiting
Health condition type	-
Study type	Interventional

Summary

ID

NL-OMON25220

Source
Nationaal Trial Register

Brief title
CO2CE

Health condition

N/a

Sponsors and support

Primary sponsor: Maastricht University
Source(s) of monetary or material Support: Maastricht University internal funding

Intervention

Outcome measures

Primary outcome

The cognitive performance measured by the CANTAB test battery

Secondary outcome

Respiration Rate, Blood pressure, Heart Rate Variability, Skin Temperature, substrate

oxidation, risk and time preferences in economic lotteries

Study description

Background summary

There is increasing evidence that the level of carbon dioxide (CO2) inside buildings can have a negative effect on the cognitive performance and long-term health of occupants. While in the past, CO2 has been used as a proxy for other harmful substances in the air, more research indicates that CO2 itself could directly cause cognition impairments and adverse physiological responses. It is assumed that a high level of ambient CO2 leads to an increased concentration of CO2 in the blood, caused by a changing breathing pattern which results in insufficient lung ventilation. This higher level of blood CO2 leads to a respiratory acidosis, characterized by a blood ph-level below 7.35 and an increased concentration of bicarbonate in the blood. Ultimately, this can lead to certain chemical and biological reactions in the brain, which impair cognitive performance. The underlying physiological mechanisms in the brain are still unknown. Moreover, the cognitive impairment due to CO2 exposure might lead to changes in individual behavior, in particular regarding individuals' risk-taking and time preferences which are key determinants in economic decision-making. However, current evidence is still inconclusive at which concentration levels CO2 starts to show these effects. There is also only limited knowledge about the effect of moderately high CO2 levels over several hours. Additionally, to the best of our knowledge, there is currently no study that investigated the effect of moderately high indoor CO2 concentration on human energy metabolism. Human energy metabolism is an important health factor in determining the risk for individuals to develop metabolic diseases such as cardiovascular disorders, stroke, and type 2 diabetes. A lower level of energy metabolism is also associated with an increased risk for obesity.
This interdisciplinary study aims to contribute new insights to different streams of literature by examining the isolated effect of medium exposure (over several hours) to CO2 on both, cognitive and behavioral responses a well as physiological parameters. This contributes to closing several research gaps. Firstly, the study will investigate whether exposure of several hours to a typically occurring indoor CO2 concentration of 0.3% affects cognition and health. Secondly, the close monitoring of subjects' physiological conditions will allow insights into possible underlying mechanisms causing cognitive impairments. Thirdly, we will investigate the effect of several hours of exposure to elevated levels of CO2 that are representative of conditions in offices on economic decision making, which allows translating the results into direct implications for firms and policy. Understanding under what conditions, cognitive capacities, health, and optimal decision-making of office workers can be optimized is key for future productivity growth and sustainable employment.

Study objective

A high indoor carbon dioxide concentration has a negative effect on the cognitive performance of occupants.

Study design

2 test days which are min. 1 month apart from each other

Intervention

Low indoor CO2 concentration vs. high indoor CO2 concentration

Contacts

Public
Maastricht University
Stefan Flagner

00433883949
Scientific
Maastricht University
Stefan Flagner

00433883949

Eligibility criteria

Inclusion criteria

• Adults between 30 to 50 years old
• White-collar workers: Individuals that conduct cognitive task and low physical effort on a daily basis
• BMI between 18.5 and 25
• Generally healthy, no medication, except for contraceptives for woman
• Non-smokers or person who quit smoking more than five years ago

Exclusion criteria

• Persons who are unemployed
• Persons with a disorder or disease (Parkinson, Attention Deficit Hyperactivity Disorder (ADHD), Alzheimer, diabetes, cardiovascular disorder, respiratory impairments (for example asthma), hypertension, obesity, or any other condition that can impair the lung function)
• Athletes: no individuals who do endurance sports on a professional basis or more than 5

times a week for more than 2 hours
• Any medication or medical condition that might interfere with the physiological outcome parameters or in some regards impair cognition
• Individuals with a high level of caffeine consumption (more than 400 mg per day)
• Shift workers
• Color blindness
• Pregnancy

Study design

Design

Study type:	Interventional
Intervention model:	Crossover
Allocation:	Non controlled trial
Masking:	Single blinded (masking used)
Control:	Active

Recruitment

NL

Recruitment status:	Recruiting
Start date (anticipated):	01-10-2021
Enrollment:	20
Type:	Anticipated

IPD sharing statement

Plan to share IPD: No

Ethics review

Positive opinion

Date:	30-09-2021
Application type:	First submission

Study registrations

Followed up by the following (possibly more current) registration

ID: 52064
Bron: ToetsingOnline
Titel:

Other (possibly less up-to-date) registrations in this register

No registrations found.

In other registers

Register	ID
NTR-new	NL9758
CCMO	NL77015.068.21
OMON	NL-OMON52064

Study results