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Press release
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How mountain air can help against asthma
Low oxygen levels can alleviate symptoms of respiratory disease

Graz, 12 October 2021: Seemingly harmless substances in the environment such as animal hair, dust or pollen that regularly enter our respiratory tract through the air can be a disaster for people with asthma. Their immune system perceives these allergens as a threat and the consequence is an asthma attack. Roughly one in 14 people in the Austrian population is affected by asthma including many children. This chronic inflammatory disease is often successfully treated with inhaled corticosteroids yet on occasion with side effects, which is why our researchers are searching for alternative treatment options. A research collaboration between the Ludwig Boltzmann Institute for Lung Vascular Research and Med Uni Graz is concerned with high-altitude treatment and analyzes the mechanisms underlying this successful therapy.

High-altitude climate therapy as an alternative to pharmacological treatments

Asthma is a complex chronic inflammatory disease that affects large numbers of Austrians. Shortness of breath, tightness in the chest and coughing are symptoms caused by an allergic reaction of the airways. The development and the severity of allergic asthma are closely connected to interior allergens such as dust mites or mold spores. A second, non-allergic form of asthma can also be caused by exertion or stress. Although inhaled medication based on corticoids such as cortisone and other specific anti-inflammatory treatments can be highly effective in treating asthma, side effects can develop that may diminish quality of life. In addition, these treatments do not lead to the desired success for all patients.
High-altitude climate therapy (HACT) was used before pharmacological treatments were available and has been applied since then to supplement these measures. "The literature contains numerous case reports that describe an improvement in allergic asthma with HACT. It has also been observed that asthma patients from high-altitude regions find their disease worsens when they are at lower altitudes. What is striking is that the positive effect of HACT can still be detected months after the person returns from the high altitude. That is why we must take a detailed look at this successful therapy," says Leigh Marsh, describing his research area. To explain these positive effects, several possible factors have been identified, including reduced allergen exposure, greater exposure to UV light, psychosomatic factors and hypoxia (lack of oxygen); however, the molecular mechanisms underlying them have not been studied sufficiently.

Low oxygen levels help with chronic respiratory disease

The team of Leigh Marsh from the LBI for Lung Vascular Research and the Division of Physiology along with the Division of Pharmacology at the Otto Loewi Research Center and the Med Uni Graz Division of Pulmonology has succeeded in detecting important cellular

mechanisms involved in altitude treatment and explaining its clinical effectiveness. During high-altitude treatment, allergic inflammation appears to be interrupted, thereby preventing a certain immunological chain reaction. For an allergic immune response to occur, so-called antigen-presenting cells must recognize the allergen and present T cells. These T cells then stimulate B cells, which ultimately produce and release specific antibodies. The result is the allergic reaction or asthma attack. "Reduced oxygen concentration inhibits these effects. Hypoxia is thus an important factor that explains the effects of staying at a high altitude," explains the researcher. In fact, the immune system chain reaction is inhibited from the very start, beginning with the antigen-presenting cells, which require a certain oxygen concentration to become fully activated. Moreover, oxygen is generally required for communication to take place between the different immune cells.

High up: Focus on high alpine conditions

The oxygen conditions simulated in the lab correspond to an altitude of around 5000 meters and represent severe hypoxia. Patients in HACT clinics experience an alleviation of their symptoms starting at 2000 m above sea level. "Our investigations serve as the policy study and identify several underlying hypoxia-dependent molecular signal pathways that might play a role in HACT. More research is necessary to determine the minimum altitude and the length of altitude exposure required for effective asthma therapy. We propose using our experimental model for further investigations. In particular, further research on hypoxia-induced effects on the immune cells and their interaction appear promising for permanently influencing allergic asthma with small interfering molecules or biological substances," says Leigh Marsh, looking to the future. The new findings might contribute to the development of new therapies and were recently published in the journal "Allergy." "In the meantime, it is not just asthmatics but all of us whose health may benefit from regularly enjoying the fresh mountain air," recommends the researcher.

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Profile
In 2020 Leigh Marsh finished his habilitation at Med Uni Graz, where he is in charge of the Chronic Respiratory and Pulmonary Diseases research area at the Otto Loewi Research Center. Since 2014 he has also been the head of the translational platform at the Ludwig Boltzmann Institute for Lung Vascular Research, which serves as a bridge between basic research and clinical research, and investigates the inflammatory aspects of pulmonary vascular disease.

Link to publication
Low oxygen levels decrease adaptive immune responses and ameliorate experimental asthma in mice: https://pubmed.ncbi.nlm.nih.gov/34309864/