

Abstract

Background: Alpine Altitude Climate Treatment (AACT) combines multidisciplinary pulmonary rehabilitation with reduced environmental exposure at moderate altitude and improves outcomes in severe asthma. Asthma symptoms show seasonal variation, but it remains unclear whether this affects rehabilitation outcomes during AACT. This study investigated whether there is an optimal treatment period for AACT and assessed the influence of environmental exposures on respiratory outcomes.

Methods: This retrospective cohort study included adults with severe or uncontrolled asthma referred to the Dutch Asthma Centre Davos between 2008 and 2024. Admissions were classified into warm, cold, or mixed periods and meteorological seasons. Outcomes included asthma control (ACQ), asthma-related quality of life (AQLQ), sino-nasal symptoms (SNOT22), and fractional exhaled nitric oxide (FeNO). Environmental exposure data included air pollution, pollen, and meteorological variables obtained from monitoring stations near the rehabilitation center. Univariable regression and multivariable ANCOVA analyses were performed adjusting for baseline score, age, sex, treatment duration, and environmental exposures.

Results: A total of 1359 admissions from 855 patients were included. Significant period effects were observed for ACQ, SNOT22, and FeNO, although differences were small and unlikely to be clinically meaningful. After adjustment for environmental variables, period effects for SNOT22 and FeNO were attenuated, whereas the association between period and ACQ became more pronounced. Significant sex interactions were identified for ACQ and AQLQ, while no significant interactions with atopic phenotype or sensitization status were observed. Several environmental exposures were associated with respiratory outcomes, although inverse associations for NO₂ and ozone likely reflected complex environmental confounding rather than protective effects. Baseline disease severity was consistently the strongest predictor of rehabilitation outcomes.

Conclusion: Pulmonary rehabilitation at altitude appears effective throughout the year, with only modest seasonal and environmental influences on respiratory outcomes. Timely referral before further deterioration of asthma control is therefore important.