American Journal of Interdisciplinary Research and Development
ISSN Online: 2771-8948
Website: www.ajird.journalspark.org
Volume 28, May - 2024

THE IMPACT OF CLIMATIC CONDITIONS ON THE FEATURES AND COURSE OF BRONCHIAL ASTHMA WITH CONCURRENT ALLERGIC DISEASES

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Abstract:
Bronchial asthma is a chronic inflammatory disorder of the airways that often coexists with other allergic diseases. The clinical manifestations and disease course of asthma can be significantly influenced by the climatic conditions of the region. This study aimed to investigate the features and progression of bronchial asthma in combination with other allergic diseases, with a particular focus on the impact of climatic factors.

Keywords: Bronchial asthma, Allergic diseases, Climatic conditions, Temperate climate, Subtropical climate, Subarctic climate, Asthma symptoms, Lung function, Biomarkers, Allergic comorbidities, Environmental factors.

Introduction

Methods:
A longitudinal, observational study was conducted in three regions with distinct climatic conditions: a temperate continental climate, a subtropical climate, and a subarctic climate. Patients with diagnosed bronchial asthma and at least one concurrent allergic disease were recruited and followed for 2 years. Clinical assessments, lung function tests, and biomarker analyses were performed at regular intervals. Meteorological data were collected from local weather stations.

Detailed Methods:

Study Design and Participants:

This was a longitudinal, observational study conducted in three regions with distinct climatic conditions: a temperate continental climate, a subtropical climate, and a subarctic climate. Patients with a diagnosis of bronchial asthma and at least one concurrent allergic disease (allergic rhinitis, atopic dermatitis, or food allergy) were recruited and followed for a duration of 2 years.

Participants were enrolled from tertiary care hospitals and allergy clinics located in each of the three climatic regions. Inclusion criteria were: 1) age between 18 and 65 years; 2) confirmed diagnosis of bronchial asthma according to the GINA guidelines; and 3) presence of at least one additional allergic disease. Participants with severe comorbidities, pregnancy, or recent changes in asthma/allergy medication were excluded.

Clinical Assessments and Lung Function Tests:
Participants underwent comprehensive clinical assessments at baseline, 6 months, 12 months, and 24 months. These assessments included:
- Detailed medical history and physical examination
- Evaluation of asthma symptoms using the Asthma Control Test (ACT)
- Assessment of allergic rhinitis and atopic dermatitis severity using validated scoring systems
- Lung function testing, including forced expiratory volume in 1 second (FEV1), forced vital capacity (FVC), and FEV1/FVC ratio, using standardized spirometry protocols.
- Documentation of asthma exacerbations, defined as worsening of symptoms requiring systemic corticosteroid use or hospitalization.

Biomarker Analysis:
Blood samples were collected at each visit for the analysis of the following biomarkers:
- Total serum immunoglobulin E (IgE) levels
- Peripheral blood eosinophil count
- Fractional exhaled nitric oxide (FeNO) levels

Meteorological Data Collection:
Meteorological data, including temperature, humidity, precipitation, and air pollutant levels (particulate matter, ozone, nitrogen oxides), were obtained from the nearest weather stations in each of the three study regions. These data were used to characterize the climatic conditions of the respective locations.
Statistical Analysis:
Descriptive statistics were used to summarize the demographic and clinical characteristics of the study participants. Repeated-measures ANOVA was employed to assess the longitudinal changes in lung function, biomarkers, and asthma/allergy symptoms across the three climatic regions. Multivariate regression models were used to evaluate the associations between climatic factors and the clinical outcomes.
Results:
The study included 450 participants (150 from each climatic region). Patients in the subtropical climate exhibited more severe asthma symptoms, higher rates of allergic rhinitis and atopic dermatitis, and more frequent exacerbations compared to those in the temperate and subarctic regions. Lung function parameters, such as FEV1 and FVC, were significantly lower in the subtropical group. Biomarkers, including eosinophil count and IgE levels, were also elevated in the subtropical cohort. Exposure to higher temperatures, humidity, and air pollutants was associated with the worsening of asthma and concurrent allergic manifestations.

Detailed Results:

Participant Characteristics:

The study included a total of 450 participants, with 150 individuals recruited from each of the three climatic regions (temperate continental, subtropical, and subarctic).

Asthma and Allergic Disease Severity:

Patients living in the subtropical climate region exhibited more severe asthma symptoms, as evidenced by lower Asthma Control Test (ACT) scores, compared to those in the temperate and subarctic regions. The rates of concurrent allergic rhinitis and atopic dermatitis were also significantly higher in the subtropical group.

Furthermore, the subtropical cohort experienced more frequent asthma exacerbations, defined as worsening of symptoms requiring systemic corticosteroid use or hospitalization, over the 2-year follow-up period.

Lung Function:

Lung function parameters, including forced expiratory volume in 1 second (FEV1) and forced vital capacity (FVC), were significantly lower in the subtropical group compared to the temperate and subarctic groups. The FEV1/FVC ratio was also reduced in the subtropical cohort, indicating poorer airflow and increased airway obstruction.

Biomarker Findings:

The analysis of blood biomarkers revealed elevated levels of total serum immunoglobulin E (IgE) and peripheral blood eosinophil counts in the subtropical group compared to the other two climatic regions. Fractional exhaled nitric oxide (FeNO) levels were also higher in the subtropical participants.

Climatic Factors and Clinical Outcomes:

Exposure to higher temperatures, increased humidity, and elevated air pollutant levels (particulate matter, ozone, and nitrogen oxides) was associated with the worsening of asthma symptoms, greater frequency of allergic comorbidities, and poorer lung function in the study participants.

Conclusions:

The features and course of bronchial asthma, when combined with other allergic diseases, are strongly influenced by the climatic conditions of the region. Patients living in subtropical environments with higher temperatures, humidity, and air pollution levels experienced more severe asthma symptoms, poorer lung function, and increased comorbidities compared to those in temperate and subarctic climates. These findings underscore the importance of considering regional climatic factors in the management of patients with asthma and concurrent allergic conditions.

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