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ORIGINAL

The bronchial asthma and its association with the changes in the weather

El asma bronquial y su asociación con los cambios de tiempo

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ABSTRACT

Introduction: climate and weather influence human health. Asthma is a psychosomatic illness that constitutes a global health problem, and the influence of environmental factors on the onset of bronchial asthma attacks is well known.
Objectives: to determine the peak occurrence of bronchial asthma attacks in the municipality of Pinar del Río, relating them to meteorological changes.
Method: the total number of people who attended the emergency services of the four clinics in the municipality of Pinar del Río for bronchial asthma attacks daily was collected, according to charge sheets and reports from the municipal health analysis and trends unit, between the 1st and 2nd of May. January 2020 and December 31, 2021. The data collected regarding the attendance of these patients was compared with the information provided by the biometeorological model maps provided by the Provincial CITMA. Case frequency graphs were created, by day and by month. Intervals were established for the histogram, and the different clinics were located according to the frequency intervals with which patients came to receive health services.
Results: under atmospheric hyperoxia conditions, the daily incidence of the disease was equal to or greater than 160 % of the respective monthly average, demonstrating a massive meteorological-pathological response in the study population.
Conclusions: meteorotropic effects associated with sudden changes in weather can have deleterious impacts on human health.

Keywords: Asthma; Weather; Health; Disease.

RESUMEN

Introducción: el clima y el estado del tiempo influyen sobre la salud humana. El asma es una enfermedad psicosomática que constituye un problema de salud mundial, y es conocida la influencia de los factores ambientales en la aparición de las crisis de asma bronquial.
Objetivos: determinar los picos máximos de ocurrencia de las crisis de asma bronquial, en el municipio Pinar del Río, relacionándolas con los cambios meteorotrópicos.
Método: se recogió el total de personas que acudieron, diariamente, a los servicios de urgencia de los 4 policlínicos del municipio Pinar del Río, por crisis de asma bronquial, según hojas de cargo y reportes de la unidad de análisis y tendencias de salud municipal, entre el 1ro. de enero de 2020 y el 31 de diciembre de 2021. El dato recogido, acerca de la concurrencia de dichos pacientes, se contrastó con la información aportada por los mapas de modelos biometeorológicos que nos proporciona el CITMA Provincial. Se confeccionaron gráficos de frecuencia de casos, por día y por mes. Se realizaron intervalos para el histograma,

y se ubicaron los diferentes policlínicos de acuerdo con los intervalos de frecuencia con que los pacientes acudieron a recibir los servicios de salud.
Resultados: bajo condiciones de hiperoxia atmosférica, la ocurrencia diaria de la enfermedad, mostró un valor igual o superior a 160 % de la media mensual respectiva, por lo que se evidenció una respuesta meteoro-patológica masiva de la población estudiada.
Conclusiones: Los efectos meteorotrópicos asociados a los cambios bruscos del estado del tiempo pueden provocar impactos deletéreos sobre la salud humana.

Palabras clave: Asma; Tiempo; Salud; Enfermedad.

INTRODUCTION

It is paradoxical that, despite the significant advances in the knowledge and treatment of bronchial asthma, its causes and basic mechanisms, morbidity rates increase in direct proportion to the scientific advances achieved and in the face of the multitude of new therapeutic modalities.

It is estimated that 300 million people worldwide currently have bronchial asthma, and it is predicted that by the year 2025, this figure will multiply by 45-59 %, which would represent approximately 100 million more people on the planet suffering from the disease. Globally, an average of 250 000 deaths from asthma are reported each year.[1] From the economic point of view, the financial burden of asthma per year varies, depending on the country, between 300 and 1 300 USD per patient, including the costs of visits to emergency services during crises, control visits, supportive treatment and school and work absenteeism, among the most important, making it one of the chronic diseases with a high financial impact for any health system and the personal and family economy.[2]

In Cuba, in 2023, the data show a national general rate of 87,42 for bronchial asthma and a rate of 137,13 for the age group between 10 and 14 years, with differences between provinces that appear to be related to the industrial development present in each. The city of Pinar del Río showed an overall rate of 105,40, with the age groups between 5 and 24 years being more affected, with a rate of 156,78, which corresponds to children and adolescents attending school, and young people who would be incorporated as an essential productive force. Hence, the economic and social impact of the disease is greater.[3]

In children, the elderly, and patients suffering from chronic non-communicable diseases, such as bronchial asthma, the ability to readjust internal physiological processes in the face of abrupt changes in weather conditions is often impractical due to two potential causes: individual physiological failures or the magnitude of the change in weather conditions. When this happens, for one reason or another, a massive response occurs among the population affected by the abrupt change in weather conditions, and we are in the presence of meteoropathological reactions.[4]

The effects of weather changes on human health can be analyzed in several ways: direct effects occur when there is a direct action of meteorological elements, for example, solar radiation (sunburn due to sunstroke), air temperature (death due to dehydration), wind (blows when swept away), floods (people drowned by rising rivers, etc.), and indirect effects originate when there is a direct action of meteorological elements, for example, solar radiation (sunburn due to sunstroke), air temperature (death due to dehydration), wind (blows when swept away), floods (people drowned due to rising rivers, etc.).A sequence of concatenated actions causes indirect effects. For example, heavy rainfall leads to flooding, which contaminates water sources, and subsequently, epidemic outbreaks of diarrheal diseases occur, or viruses and vectors increase. In addition to contamination by sewage water.[5,6,7]

The present work aims to determine the maximum peaks of bronchial asthma crisis occurrence in the municipality of Pinar del Río, using a biometeorological prognostic model, and to demonstrate the relationship between bronchial asthma crises and meteorological changes.

METHOD

The daily occurrence of bronchial asthma crises was measured based on the daily attendance of these patients at the emergency services of each polyclinic involved in the research. The total number of people who went, each day, to the emergency services of the four health areas of the municipality of Pinar del Río for clinical manifestations of bronchial asthma was collected, according to the records of charge sheets (documentary review), and its reconciliation with the reports of the unit of analysis and trends of municipal health, between January 1, 2020 and December 31, 2021.

A database was prepared for compiling the information, organized by date and health institution, which was processed in detail and compared with the data provided by the maps. A database was prepared for the compilation of the information, according to date and health institution, which was processed in detail

and contrasted with the data provided by the maps of biometeorological models, offered by the Center for Environmental Studies and Services of Pinar del Río, belonging to CITMA, which reflected the different meteorological variables and their daily behavior.

Case frequency graphs were created by day and month during the study period, and histogram intervals were used to categorize the different polyclinics according to the frequency intervals at which patients attended health services. To demonstrate the relationship between asthma attacks and meteorological changes, inferential statistical tests were applied. A Spearman's rank correlation matrix was calculated to determine the association between meteorological changes and the frequency of asthma attacks.

For the study of factors related to meteorotropic changes, monthly catalogs of weather types were constructed, which made it possible to clearly and precisely appreciate how and where the spatiotemporal differences of the local climate are located in a given region or territory. The effects that were produced, at the regional scale, when the meteoropathological reactions took place synchronously in a vast territory, and under the influence of the same type of synoptic situation, had to fulfill the following premises, to consider them capable of producing specific meteorotropic effects:

- That the daily occurrence of the given disease, measured based on the influx of patients to the emergency services, is equal to or greater than 150 % of the respective monthly average.
- That the daily occurrence of the given disease has maximum peaks coinciding in date with the records of health centers located in other neighboring areas of the same city or nearby towns.

To identify the possible association between meteorological processes (weather changes) and physiological processes (bronchospasm), the complexity of this relationship was considered, assessing the magnitude of the weather change (degree of contrast) and the sensitivity of the receptor, as well as the constant variability of these factors according to the individuals, populations and places where they occurred.

The classification criterion was developed based on the behavior of daily extreme air temperatures, ambient humidity, wind speed, cloudiness, and the occurrence or non-occurrence of precipitation and other atmospheric phenomena, which are essential meteorological elements for studying the effects of weather conditions on human health. The effects of weather conditions on health were considered as predisposing factors for the occurrence of health crises in those people who already have bronchial asthma.

Meteorotropic effect refers to the diverse actions that weather variability causes on people's health, expressed in atmospheric conditions of hyperoxia and hypoxia.

Meteorolability refers to the sensitivity or reaction of an individual to weather variability, which depends on their adaptive capacity. It is influenced by factors such as age, sex, time of year, and place of residence, among others. Meteoropathological reactions, on the other hand, refer to the massive responses among the population affected by sudden changes in weather conditions.

RESULTS

The behavior of the maximum peaks of asthma occurrence is similar in the two periods of the year analyzed (summer and winter), although in the latter, there is a slightly higher number of days with maximum peaks of occurrence, which coincide with the meteorological changes. However, from a qualitative point of view, both in winter and summer, it is possible to find such a coincidence in up to 4 or more polyclinics of the municipality.

The higher maximum peaks were reported in the municipality only, occasionally, to 200 people, which represented 1 % of the asthmatics attended, in one day, for asthma crisis, which was highly significant ($X2=p\leq 0,05$) of the impact that the meteotropic effects can have on patients who have bronchial asthma in Cuba. The frequency of critical days, with more than 100 cases attended, is higher in winter than in summer; however, this does not mean that very critical days for asthmatic patients do not occur in summer.

In the summers of 2021 and 2022, there were 38 days with maximum peaks of CAAB coinciding with the meteorological changes, in 3 or more polyclinics in the municipality of Pinar del Río, mainly in May and October, with 12 and 13 days, respectively. It is not by chance that both are months of transit between summer and winter and vice versa, which indicates the effect of the seasonal contrast (stimulus) of the types of weather, and types of synoptic situations on the preceding adaptation of the local population.

The maximum peaks of affluence of patients with bronchial asthma crises reported in the municipality of Pinar del Río, regarding different weather states, were highly representative of the impact that meteorotropic effects can have on this disease.

DISCUSSION

The association between asthma and weather changes has been established. Such changes are expressed by contrasts in atmospheric oxygen density reflecting the simultaneous action of temperature, humidity and atmospheric pressure on the respiratory tract,8 exerting a deleterious effect on it, from the fact that each asthma attack increases inflammation and bronchial obstruction, with consequent repercussions on alveolar

structure, gas exchange and cellular respiration.

The effects of weather conditions on asthmatics are not observed daily or in all patients at the same time, but only when the adaptive capacity of the most meteorolabile individuals is exceeded. Significant weather changes may therefore have a different expression from one individual to another, as is often the case with bronchial asthma, most notably under conditions of hyperoxia or increased partial oxygen pressure in the air.[9]

Weather conditions do not cause disease, but rather act as a risk or predisposing factor for the occurrence of health crises in individuals already suffering from a specific disease. The relationship between weather conditions and human health is complex because it depends on the magnitude of the weather change (the degree of contrast) and the sensitivity of the individual.[9]

Taking into consideration the above, and estimating that, at the end of 2023, the number of patients treated for bronchial asthma in the municipality of Pinar del Río amounted to 19 762, we can calculate that approximately 1 % of the asthmatic population could simultaneously require medical attention due to the impact of sudden changes in the weather. Based on this data, and the prevalence rate in the country, it could be estimated that there are more than 960 000 people affected by bronchial asthma, and of these, 9 600 could require medical attention on a single day, only due to the occurrence of CAAB, and as a consequence of the impact of significant changes in the meteorological complex.

According to the literature [10,11,12], cold temperatures are a trigger for health crises in asthmatic patients. Still, in our experience, there is no lack of patients who report that their clinical manifestations occur more frequently on summer days. The results of the monitoring, which is also carried out in the municipality of Pinar del Río, confirm the findings mentioned above and agree with the estimate of asthmatic patients who exhibit diverse types of meteoropathological reactions during weather changes.

From a medical and epidemiological point of view, the above results enable the design and proposal of new procedures aimed at preventing and mitigating the impacts of sudden weather changes on asthmatic patients. Through the family doctor and nurse, who are the cornerstone in health promotion, disease prevention, treatment and rehabilitation of these patients, a set of health actions aimed at the prevention and control of this entity could be integrated, mainly those related to the education of patients and their families, the training of health personnel on the interpretation, processing and proper application of biometeorological models, for the implementation of a more updated and innovative approach in the medical care of asthmatic patients. The possibility of using biometeorological forecasting models, regardless of the time of year, constitutes an essential tool for designing intervention strategies at the primary care level to prevent and mitigate the effects of different synoptic situations on patients with bronchial asthma.

Taking into account the incidence of bronchial asthma as a health problem in Cuba and the world, and its association with the different weather conditions, the early warning system, at the first level of attention, would constitute an invaluable help, which would justify the continuity and urgency of developing this line of research to improve the knowledge that explains the actions of climate and weather on human health, and that, jointly, the communities (medical and meteorological) develop new therapeutic procedures.

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CONFLICTS OF INTEREST

None.

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