



ORIGINAL ARTICLE

Impact of meteorological factors on the emergence of bronchiolitis in North-western Greece

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Abstract

Objective: To evaluate the relationship between meteorological factors in North-western Greece and the incidence of bronchiolitis.

Methods: Meteorological data (air temperature and rainfall) for Ioannina city in North-western Greece and medical data from hospitalised patients at University Hospital of Ioannina were collected between January 2002 and December 2013. The association between meteorological factors and rate of hospitalisation due to bronchiolitis was investigated. The data processing was done using the Pearson product-moment correlation coefficient and applying the chi-square test at contingency tables of the parameters.

Results: Of the 792 hospitalised cases, 670 related to infants (<1 year) and 122 concerned patients aged 1–2 years old. The disease is more common among boys (59.5%) than girls (40.5%). The disease course through the year has a double variation with a main maximum in March and a main minimum in August. The statistical study showed statistically significant correlation of bronchiolitis with: (a) the temperature parameters on an annual basis; (b) precipitation in autumn and dryness in spring; and (c) with sudden changes in diurnal temperature range on an annual basis.

Conclusion: A peak incidence of bronchiolitis was noticed in cold and wet seasons during the five days preceding hospitalisation.

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Introduction

Bronchiolitis is an acute inflammatory injury of the bronchioles that is usually caused by a viral infection. Although

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it may occur in persons of any age, severe symptoms are usually only evident in young infants. Bronchiolitis usually affects children younger than two years, with a peak in infants aged 3–6 months. Most cases of bronchiolitis result from a viral pathogen,¹ such as respiratory syncytial virus (RSV:64%), human metapneumovirus (hMPV:9–30%), rhinovirus (RV:16%), parainfluenza virus (HPIV), influenza virus (IV:6%), or adenovirus. Risk factors for the development of bronchiolitis include²: low birth weight, gestational age, lower socioeconomic group, parental smoking, chronic lung disease, neurologic diseases, congenital heart diseases, congenital or acquired immune deficiency diseases, age less than three months and airway anomalies.

Furthermore, the effect between various meteorological variables on the incidence of lower respiratory tract infections has been a matter of investigation for the scientific community for decades.^{3–5} Many studies have been published exploring the impact of meteorological factors on the incidence of respiratory tract infections (RTI), but there is only limited data comparing the impact of such factors on bronchiolitis specifically.

RSV is the leading cause of bronchiolitis. Our knowledge of how epidemics of RSV are initiated is incomplete. In geographical regions with temperate climates, epidemics of RSV have been reported to peak during winter in both the Northern and Southern Hemispheres.^{6,7} This suggests that cold weather may increase RSV activity. In contrast, RSV activity has been described as being continuous throughout the year in warm equatorial areas,^{8,9} suggesting that temperature cannot be the only factor influencing activity of the virus. Recent studies¹⁰ suggest that although no clear connections were found between monthly temperatures/precipitation and RSV outbreaks apart from seasonality, a linkage to winter time cold spells was apparent on a daily basis. Unevenly, low minimum temperatures from the day of admittance to 10 days before were interestingly observed.¹⁰

Thus the present retrospective study aimed at evaluating the trend of bronchiolitis over an eleven-year period in the Ioannina (Greece) area and detecting a possible relationship with specific meteorological factors, such as air temperature and rainfall. An improved understanding of the relationship between meteorological factors and bronchiolitis may facilitate measures to reduce the incidence of the disease during adverse meteorological conditions.

Patients and methods

Setting

University Hospital of Ioannina (UHI) is west Greece's largest health fund and serves as health care provider, supplying most of the health care services within its system. These services include primary, secondary, and tertiary care, as well as pharmacies and paramedical services.

In UHI, children are predominantly treated at community private clinics by board-certified paediatricians.

Ioannina is the capital and largest city of Epirus, an administrative region in north-west Greece. The territory of Ioannina has a population of about 168,000 inhabitants. It lies at an elevation of approximately 500 m (1640 ft) above sea level on the western shore of lake Pamvotis. It is located

55 km (35 miles) east of the port of Igoumenitsa on the Ionian Sea.

Data collection

Medical data

This retrospective study included medical records from children aged up to two years, admitted to UHI and discharged between January 2002 and December 2013. Children were included if classified by their physician as having an underlying diagnosis of bronchiolitis. Among these children, we analysed acute episodes of bronchiolitis (AEB), presented at the emergency department of the UHI. Patients were managed per the discretion of the attending physician in the emergency department. We obtained the demographic data, the medical history and a detailed history of the current illness.

The distribution of AEB is described by age, sex and seasonality for hospitalisations to describe trends.

Meteorological data

The meteorological data basis consists of daily values of maximum air temperature (T_{\max}), minimum air temperature (T_{\min}) and precipitation (R) for the 11-year period 2002–2013 recorded at the meteorological station of the University of Ioannina. The aforementioned area of Ioannina, has a borderline humid subtropical (*Cfa*) and Mediterranean climate (*Csa*) in the Köppen climate classification, since only two summer months have fewer than 40 millimetres (1.6 in) of rainfall, preventing it from being classified as solely humid subtropical or Mediterranean. Summers are typically hot and moderately dry, while winters are wet and colder than on the coast with frequent frosts and occasional snowfall.¹¹ Ioannina is one of the wettest cities in Greece with a total annual precipitation of approximately 1100 mm. From the above parameters, mean daily temperature $T_{\text{mean}} = (T_{\max} + T_{\min})/2$ and diurnal temperature range ($T_{\text{range}} = T_{\max} - T_{\min}$) were calculated. Also, the day-to-day changes of the above temperature parameters (T_{\max} , T_{\min} , T_{mean} and T_{range}) were calculated. Since the incubation time of the respiratory viruses ranges from one to five days, with a mean period of three days, the mean values of the four temperature parameters and their maximum (absolute) changes (Differences) ($DT_{\max+}$, $DT_{\min+}$, $DT_{\text{mean}+}$, $DT_{\text{range}+}$, $DT_{\max-}$, $DT_{\min-}$, $DT_{\text{mean-}}$, $DT_{\text{range-}}$) during the five days preceding hospitalisation were used in the analysis. Furthermore, precipitation was calculated for 10-day intervals before the admissions as too many of the five-day intervals were completely dry.

At first, the five-day values of all the parameters were distributed in quintiles (20% intervals) and the corresponding histograms were constructed. Subsequently, for a quantitative assessment of the connection between the admissions and the meteorological parameters, for each quintile, the number of days with none, one, two and more than two AEB cases was estimated and a contingency table was constructed for each parameter. Chi-square (χ^2) test was applied on each contingency table in order to investigate the statistical significance of the relation between the sampling distributions.

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