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Respiratory syncytial virus bronchiolitis, weather conditions and air pollution in an Italian urban area: An observational study

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ABSTRACT

Background: In this study we sought to evaluate the association between viral bronchiolitis, weather conditions, and air pollution in an urban area in Italy.

Methods: We included infants hospitalized for acute bronchiolitis from 2004 to 2014. All infants underwent a nasal washing for virus detection. A regional agency network collected meteorological data (mean temperature, relative humidity and wind velocity) and the following air pollutants: sulfur dioxide, nitrogen oxide, carbon monoxide, ozone, benzene and suspended particulate matter measuring less than 10 µm (PM_{10}) and less than 2.5 µm ($PM_{2.5}$) in aerodynamic diameter. We obtained mean weekly concentration data for the day of admission, from the urban background monitoring sites nearest to each child's home address. Overdispersed Poisson regression model was fitted and adjusted for seasonality of the respiratory syncytial virus (RSV) infection, to evaluate the impact of individual characteristics and environmental factors on the probability of a being positive RSV.

Results: Of the 723 nasal washings from the infants enrolled, 266 (68%) contained RSV, 63 (16.1%) rhinovirus, 26 (6.6%) human bocavirus, 20 (5.1%) human metapneumovirus, and 16 (2.2%) other viruses. The number of RSV-positive infants correlated negatively with temperature ($p < 0.001$), and positively with relative humidity ($p < 0.001$). Air pollutant concentrations differed significantly during the peak RSV months and the other months. Benzene concentration was independently associated with RSV incidence ($p = 0.0124$).

Conclusions: Seasonal weather conditions and concentration of air pollutants seem to influence RSV-related bronchiolitis epidemics in an Italian urban area.

1. Introduction

Knowledge on lower respiratory-tract infections in infants, especially bronchiolitis, has changed over the years mainly owing to recent etiological, clinical and prognostic findings (Turunen et al., 2014; Midulla et al., 2010). Viral bronchiolitis is a common disease whose epidemiology is linked to seasonal changes in respiratory viruses. The possible link between climate factors, air pollution and increased childhood morbidity and mortality from respiratory diseases is therefore of interest (Darrow et al., 2014).

Previous studies have reported associations between air pollution and reduced lung function, increased hospital admissions, increased respiratory symptoms, and asthma medication use (Simoni et al., 2015; Jalaludin et al., 2004). Although many consider the first years of life an especially vulnerable period, few studies have focused on the effect of meteorology and air pollution on acute viral respiratory infections in this age group (Ségala et al., 2008; Vandini et al., 2013).

In this prospective study, we sought to assess the association between acute viral bronchiolitis, weather conditions and air pollution in infants hospitalized for bronchiolitis over 10 years in Rome, Italy. To achieve this, we analyzed epidemiological data for 14 respiratory viruses detected in nasal washing samples and mean weekly data for weather conditions (temperature, relative humidity and wind velocity) along with air pollutant concentrations from the regional agency for environmental protection (ARPA) network (http://www.arpalazio.net/main/aria/doc/pubblicazioni).

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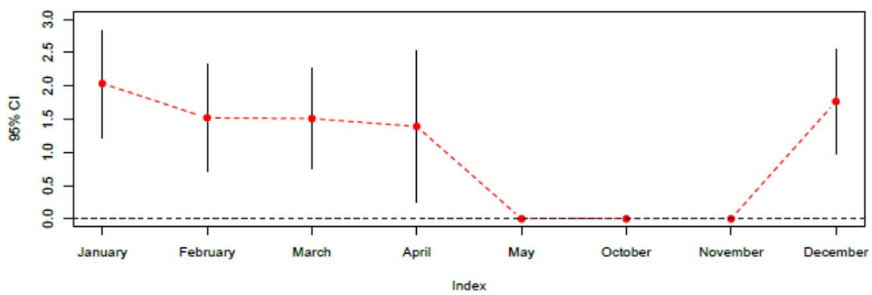

Fig. 1. 95% confidence intervals of the month effect in the Poisson regression model.

2. Materials and methods

We reviewed the clinical records of prospectively enrolled consecutive full-term young infants with a diagnosis of acute viral moderate-severe bronchiolitis, hospitalized in the Pediatric Emergency Department, “Sapienza” University, Rome, Italy during 10 annual seasonal epidemics (October-May) from 2004 to 2014 (Cangiano et al., 2016). The University Hospital of the "Sapienza" University is a tertiary care and teaching center and is the second major Pediatric hospital in Rome, Italy. It covers about 1/3 of roman children, in particular those who live in the center-and northern-east areas of the city.

Bronchiolitis was defined as the first acute lower-airway infection in children < 1 year old, with a history of upper respiratory tract infection followed by acute onset respiratory distress with cough, tachypnea, chest retractions and diffuse crackles on auscultation (Midulla et al., 2010). Exclusion criteria were underlying chronic diseases (including cystic fibrosis, chronic pulmonary diseases, congenital heart diseases and immunodeficiency) and prematurity. Patients’ demographic and clinical data were collected through the clinical records and from a structured questionnaire filled in by parents on enrollment.

The research and ethics committee of the Hospital Policlinico “Umberto I” approved the study protocol and the written informed consent that was acquired from parents of each child at admission in the study.

2.1. Virus detection

As part of our routine, from 1 to 3 days after hospitalization, all infants underwent nasal washing obtained by injecting a 3-mL sterile saline solution into each nostril and collecting the respiratory specimen with a syringe. All samples were delivered on ice within 1–2 h to the virology laboratory and on arrival, if needed, were vortexed with beads to dissolve mucus. A 200 µL aliquot for each respiratory specimen was subjected to nucleic acid extraction with the total nucleic acid isolation kit (Roche Diagnostics, Mannheim, Germany), and eluted with 50 µL of the supplied elution buffer. A panel of either reverse transcriptase (RT)-PCR or nested PCR assays was developed for detecting 14 respiratory viruses, including RSV, influenza virus (IV) A and B, human coronavirus (hCoV) OC43, 229E, NL-63 and HUK1, adenovirus, rhinovirus (RV), parainfluenza virus (PIV) 1–3, human bocavirus (hBoV) and human metapneumovirus (hMPV), as previously described (Pierangeli et al., 2008).

2.2. Meteorological data and air pollutants

Meteorological data for the geographic area of Rome (temperature, °C; relative humidity, % and wind velocity, Km/h) were recorded from Rome Meteorological Stations. Data were analyzed by year of recruitment, based on the date of admission and on each patient's residential address; data were summarized as mean values for each week during the 10-year study. The air quality network, owned and operated by ARPA Lazio (http://www.arpalazio.net/main/aria/doc/pubblicazioni), currently has 41 chemical measuring stations, some also equipped with meteorological sensors, distributed across five provinces with 21 municipalities. The ARPA Network routinely measured air pollutants. We retained data from the urban background monitoring sites only. These sites are representative of ambient air pollution in the Rome area. We obtained mean weekly concentration data for the day of admission, from the urban background monitoring sites nearest to each child's home address. We chose “a priori” to use mean exposure during the week before admission since the incubation period of bronchiolitis is very short (less than 5 days).

The following air pollution data were recorded: sulfur dioxide (SO_2) concentration (measured using ultraviolet fluorescence); nitrogen dioxide (NO_2) concentration (measured using chemiluminescence); carbon monoxide (CO) concentrations (measured using a continuous analyzer based on the spectrophotometric technique of non-dispersive absorption of infrared radiation around 4600 nm according to the law of Lambert-Beer) levels of suspended particles with an aerodynamic diameter less than 10 and 2.5 µm (PM_{10}, $PM_{2.5}$, measured by absorption of beta radiation); ozone (O_3) concentrations (measured using spectrophotometric technique of absorption, by ozone molecules, of ultraviolet radiation of 254 nm wavelengths); benzene (BZ) concentrations (measured using gas chromatography technique).

2.3. Statistical analysis

Continuous variables are expressed as arithmetic means ± SD or median (IQR) depending on their distribution and as the number and percentages for categorical variables.

Pearson's correlation was used to correlate the number of RSV- or RV-positive cases with meteorological variables and mean air pollutant concentrations.

Overdispersed Poisson regression model was fitted to evaluate the impact of individual characteristics and environmental factors on the probability of a being positive RSV (Fig. 1). In this model the dependent variable was the monthly count of positive RSV and independent variables were the air pollutants NO_2, PM_{10}, SO_2, BZ and O_3. In order to adjust for seasonality of the RSV infection, time trend was modelled by introducing the effect of month. As recommended by Cameron and Trivedi (Cameron and Trivedi, 2009) we used robust standard errors for the parameter estimates to control for mild violation of the distribution assumption that the variance equals the mean. Robust standard errors and p-values were calculated accordingly.

In order to evaluate if the proposed model captures the seasonality of the phenomenon we analyzed the residuals of the model according to the autocorrelation plot and the partial autocorrelation- The Ljung–Box test applied to the residuals of the model has been involved in order to reveal significant autocorrelations. We test the goodness of fit of the overall model using the residuals deviance. The residual deviance is the difference between the deviance of the current model and the maximum deviance of the ideal model where the predicted values are identical to the observed. Therefore, if the residual difference is small enough, the goodness of fit test will not be significant, indicating that the model fits the data.

All computations were done using R Statistical Software (http://www.R-project.org/).

The viral peak was determined as the 3 months with the highest

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همکاران ما در حال تلاش برای رفع این مشکل هستند

لطفاً درخواست خود را در ساعات دیگری مجدداً تکرار فرمایید و اگر باز هم با این مشکل رو به رو شدید، از طریق فرم تماس با ما به واحد پشتیبانی اطلاع دهید

برای یافتن مطلب مورد نظر خود می توانید از روش های جستجوی زیر استفاده فرمایید :

جســـــتجو در میـــان موضوعات

برای جستجو در میان موضوعات، به محض این که عبارت خود را در فیلد زیر بنویسید، موضوع های مرتبط در درخت سمت چپ با رنگ متمایزی مشخص می شوند.

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اگر موضــوع مــورد نظر شـــما در لیســت موضوعات اصلی وجود نداشت، با استفاده از فیلـــد زیر می توانیـــد آن را در بیـــن کل مقاله های سایت جستجو فرمایید.

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همکاران ما در واحد پشتیبانی آمادگی دارند تمامی درخواست های شما عزیزان را بررسی نموده و در اسرع وقت رسیدگی نمایند

پیگیری خرید مقاله

پس از خرید هر مقاله، یک کد رهگیری منحصر به فرد به شما تقدیم خواهد شد که با استفاده از آن می توانید وضعیت خرید خود را پیگیری فرمایید

کد رهگیری

ارسال

پیگیری سفارش ترجمه

با ثبت کد رهگیری پرداخت، می توانید سفارش خود را پیگیری نموده و به محض اتمام ترجمه، فایل ترجمه مقاله خود را دانلود نمایید

کد رهگیری

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