

Seasonality of respiratory syncytial virus in Buenos Aires. Relationship with global climate change

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ABSTRACT

Introduction. Global climate change circulation pattern respiratory syncytial virus (RSV). We assessed whether RSV season has changed over the past 20 years and its correlation with mean annual temperature.

Methods. Cross-sectional study that included records of RSV and temperatures from Buenos Aires (1995-2014). RSV season onset, offset and duration, and its correlation with mean annual temperature were described for each year.

Results. A total of 8109 RSV infections were identified. The duration of RSV season reduced significantly (1995: 29 weeks vs. 2014: 17 weeks; $R: 0.6; p < 0.001$) due to an early ending (1995: week 45 vs. 2014: week 33; $R: 0.6; p < 0.001$). No correlation was observed between mean annual temperature and RSV season start, end and duration.

Conclusion. Over the past 20 years, RSV season shortened significantly, but no correlation with temperature was observed.

Key words: human respiratory syncytial virus, respiratory tract infections, climate change, global warming.

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INTRODUCTION

Acute respiratory infections are a major cause of morbidity and mortality, and respiratory syncytial virus (RSV) is the most common agent in children younger than 2 years old.¹ Although the global burden of RSV is unknown, it has been estimated that between 66 000 and 199 000 children died in 2005 worldwide due to an acute respiratory infection associated with RSV.¹

The season of RSV circulation varies depending on the region and its climate, and its onset and duration may change due to environmental conditions.² In temperate climate zones, RSV circulates during the fall and winter, in association with lower temperatures and increased humidity.³

In the past years, the greenhouse effect has resulted in global warming and increased average temperatures. In the beginning of the 21st century, the mean global temperature was 0.6 °C higher than that of the 20th century.⁴ In addition, a phenomenon known as the “urban heat island” has contributed to having higher local temperatures, a situation that has been extensively documented in the city of Buenos Aires.⁵

Such changes in local climate may have an impact on RSV circulation patterns. Thus, Donaldson has found in England that the RSV infection period has shortened in relation to higher temperatures.⁶

Knowledge of changes in RSV circulation patterns is essential to design specific health actions, which may even have an impact on the implementation of certain preventive measures, such as the administration of palivizumab.⁷

To date, there are no publications in our setting reviewing a likely relationship between climate change and modifications in RSV circulation. Our objective is to assess whether the duration of the RSV season has changed over the past 20 years and if the change in mean annual temperature is correlated to RSV season.

MATERIAL AND METHODS

This was a cross-sectional study using RSV identification records from a children’s hospital located in the city of Buenos Aires between 1995 and 2014, ordered by epidemiological week (data from the hospital’s Lab Department). Mean annual temperature records (in degrees Celsius) for the 1995-2014 period in the city of Buenos Aires were provided by the National Weather Service.

Outcome variables:

- Start of the RSV season: For each year, the first epidemiological week when the number

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of RSV cases identified is above 60% from the average weekly identifications for that year.⁶

- End of the RSV season: For each year, the first epidemiological week when the number of RSV cases identified is below 60% from the average weekly cases for that year.⁶
- Duration of the RSV season: For each year, the number of epidemiological weeks from start to end of the RSV season.

Statistical considerations: For each year, onset, offset and duration of the RSV season and mean annual temperature are described; variations in each parameter were assessed by simple linear regression. In addition, average values corresponding to the number of weeks of duration, start and end between both halves of the study period (1995-2004 vs. 2005-2014) were compared using Student's t test. The correlation between mean annual temperature and RSV season start and end (epidemiological week number) and between mean annual temperature and RSV season duration (in epidemiological weeks) was assessed using Pearson's correlation (P coefficient).

Ethical considerations: Data on temperature are publicly available. Data referred to RSV are absolutely dissociated from any personal information.

Institutional approval was requested and obtained (institutional review board and ethics

committee). The study was registered at the Registro Público de investigaciones del Gobierno de la Ciudad de Buenos Aires (no. 467/14).

RESULTS

A total of 8109 cases of RSV were identified in the study period. Mean annual temperatures and start, end and duration of the RSV season were analyzed (Table 1).

RSV season started in week 17 both in 1995 and 2014 (the earliest onset week was week 11, while the latest one was week 20; median= 17; R: 0.02; $p= 0.4$).

RSV season ended in week 45 in 1995 and in week 33 in 2014 (the earliest ending week was week 28, while the latest one was week 47; median= 39; R: 0.6; $p < 0.001$).

RSV season lasted 29 weeks in 1995 and 17 weeks in 2014 (the shortest season lasted 15 weeks, while the longest one lasted 35 weeks; median= 24; R: 0.6; $p < 0.001$) (Figure 1).

The comparison between the first half of the study period (1995-2004) and the second half (2005-2014) shows a shorter season duration (28.8 vs. 18.3 weeks; $p < 0.001$) and an earlier end (week 42.5 vs. week 34.4; $p < 0.001$), with no differences in season start (week 15.56 vs. week 16.7; $p= 0.2$).

Mean annual temperature was 17.8 °C in 1995 and 18.3 °C in 2014, with a yearly average increase of 0.02 °C (R: 0.04; $p= 0.2$) (Figure 1).

TABLE 1. Season of circulation of respiratory syncytial virus and average annual temperature in the city of Buenos Aires

Year	Season of circulation of respiratory syncytial virus			Mean annual temperature
	Start week	End week	Duration	
1995	17	45	29	17.8
1996	20	47	28	18.3
1997	13	39	27	18.5
1998	17	46	30	17.8
1999	11	40	35	17.7
2000	12	39	29	17.7
2001	16	47	24	18.4
2002	16	40	32	18.0
2003	18	46	24	17.7
2004	17	36	30	18.1
2005	18	38	21	17.9
2006	17	39	19	18.2
2007	17	33	17	17.4
2008	18	36	19	18.5
2009	17	39	23	18.2
2010	14	28	15	18.2
2011	14	30	17	17.9
2012	17	32	16	18.3
2013	18	36	19	18.1
2014	17	33	17	18.3

No correlation was observed between mean annual temperature and duration ($P: 0.24$; $p = 0.2$), start ($P: 0.2$; $p = 0.4$) or end ($P: 0.28$; $p = 0.7$) of the RSV season.

DISCUSSION

In most parts of the world, it has been verified that mean annual temperature has increased; in some regions, such increase was more than 2 °C. In Argentina, the increase in temperature during the 20th century was slightly below the global average; however, over the past decades, a trend towards extreme temperatures and heat waves has been confirmed.⁸

Environmental impact on health has been widely documented, especially in relation to climate and air pollution. Climate may have a more marked effect on respiratory diseases.⁹ It has been estimated that such environmental impact on health will gain much significance in the short term.¹⁰

Respiratory syncytial virus infection is one of the most common infections during childhood and has a remarkable health, financial and social impact worldwide.¹¹

In spite of the fact that, in settings with appropriate access to the health system, RSV infection may be adequately managed, the extent of this condition implies a massive use of resources, making it mandatory to adequately plan strategies to fight RSV.¹² A better understanding of factors determining virus circulation will help to improve effectiveness in terms of use of resources.

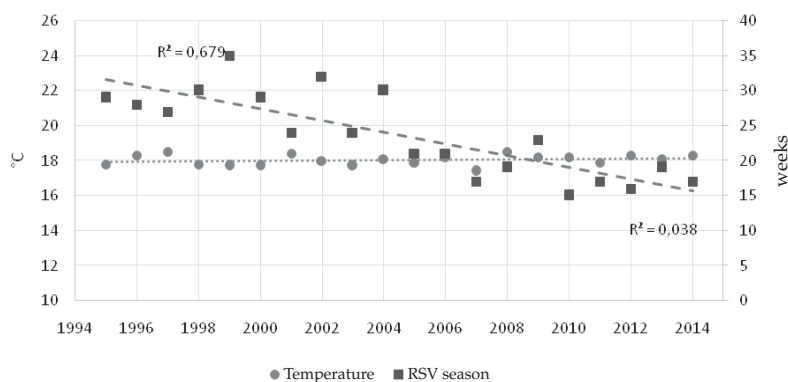
Particularly in relation to burdensome measures, such as the use of palivizumab,¹³ cost-effectiveness is a conclusive factor at the time of deciding its

use. Recently, variations in this equation have been calculated based on different estimations of bronchiolitis mortality rates.¹⁴ Similarly, it is highly likely that a consistently shorter RSV season may warrant a modification in the number of monoclonal antibody doses, which may substantially improve the cost-effectiveness of this measure.

A limitation of this study is that it is restricted to only one site. However, data used in this study were obtained from a hospital that has participated in the National Epidemiological Surveillance System since its creation, its techniques are completely standardized, and most of its patients are from the community they represent.

In the study period, it was possible to verify a gradual shortening in the duration of RSV season at the expense of an increasingly earlier season ending. This is consistent with data reported by the United States Centers for Disease Control and Prevention (CDC) for the past years (RSV seasons that last, in average, 17 weeks).¹⁵ However, the time series selected here (20 years) was short, so it is not possible to show significant differences in mean temperature. This may explain why it was not possible to demonstrate a correlation between an increase in temperature and a shorter duration of the RSV season. Considering that with slightly longer periods it is possible to verify significant changes in mean annual temperature,⁸ it is reasonable to believe that RSV data corresponding to a longer period would allow to obtain similar results to those described by Donaldson.⁶

FIGURE 1. Mean annual temperature and duration of the respiratory syncytial virus season, city of Buenos Aires, 1995-2014 period.



CONCLUSION

Over the past 20 years, RSV season has shortened significantly in the city of Buenos Aires. No correlation was observed between mean annual temperature and the duration, start or end of the RSV season.

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