

Concentration of Nitrogen Dioxide and its relationship in acute respiratory infections in children under 5 years old in Lima

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Resumen

La contaminación del aire es un problema medio ambiental cada vez más común, que va repercutiendo en la salud de los pobladores de las ciudades principales del mundo, viéndose los más vulnerables las mujeres gestantes, las personas de tercera edad y los niños de sectores que carecen de economía y sectores excluidos. La ciudad de Lima, Peru muestra un acelerado incremento de industrialización, comercialización, un gran flujo y congestión vehicular, generando altos niveles de concentración de dióxido de nitrógeno. Para obtener las concentraciones se utilizó el método pasivo durante un tiempo de exposición semanal. Los casos registrados de infecciones respiratorias agudas fueron obtenidos del Centro Materno Infantil "Los Sureños". De los resultados obtenidos la normalidad, para dióxido de nitrógeno dio como valor 0.293 y un valor de 0.514 para infecciones respiratorias agudas. El valor de correlación de Pearson es 0.862 para la concentración de dióxido de nitrógeno y casos de infecciones respiratorias agudas en niños menores de 5 años. En conclusión se pudo determinar que si existe una fuerte correlación entre la concentración de dióxido de nitrógeno y las infecciones respiratorias agudas.

Palabras clave: Contaminación del Aire, Dióxido de nitrógeno, infecciones respiratorias agudas.

Abstract

Air pollution is an increasingly common environmental problem, affecting the health of people in the world's major cities, with the most vulnerable being pregnant women, the elderly and children in economically deprived and excluded sectors. The city of Lima, Peru shows an accelerated increase of industrialization, commercialization, a great flow and vehicular congestion, generating high levels of nitrogen dioxide concentration. In order to obtain the concentrations, the passive method was used during a weekly exposure time. The registered cases of acute respiratory infections were obtained from the Centro Materno Infantil "Los Sureños". Of the results obtained normal, for nitrogen dioxide gave a value of 0.293 and a value of 0.514 for acute respiratory infections. The Pearson correlation value is 0.862 for the concentration of nitrogen dioxide and cases of acute respiratory infections in children under 5 years of age. In conclusion, it was possible to determine whether there is a strong correlation between nitrogen dioxide concentration and acute respiratory infections.

Keywords: Air Pollution, Nitrogen dioxide, acute respiratory infections.

1. Introduction

Air quality is a major problem given the impact it can have on ecosystems and the health of vulnerable populations such as children, expectant mothers and the elderly.

According to WHO, 92% of the world's population live in places where atmospheric quality levels exceed environmental quality standards, constituting an environmental health risk. In addition, this organization estimates that 3 million deaths on the planet are linked to exposure to air pollution. According to studies carried out by the WHO, they affirm that they are related to exposure to air pollution, cerebrovascular accidents, cardiovascular diseases and cancer. They also state that air pollution directly influences the development of respiratory diseases, such as obstructive neuropathies and acute respiratory infections (ARIs) (WHO, 2004; Paredes, 2016).

Nitrogen dioxide is a contaminating gas that is present in the air, with vehicular congestion taking precedence, being considered a risk for the development of respiratory infections, generating acute damages, inflammation and bronchial hyperreactivity (Gutierrez et al, 2017).

In Peru, 492 986 cases of ARIs were reported in children under 5 years of age, being considered the first cause of morbidity in 2016; where the department of Lima ranks third with 11% of reported cases (MINSa, 2016).

2. Materials and Methods

The present investigation began by the location of the monitoring points, the main avenues with greater flow of people and vehicles were taken into account, as well as factories that are around the study area.

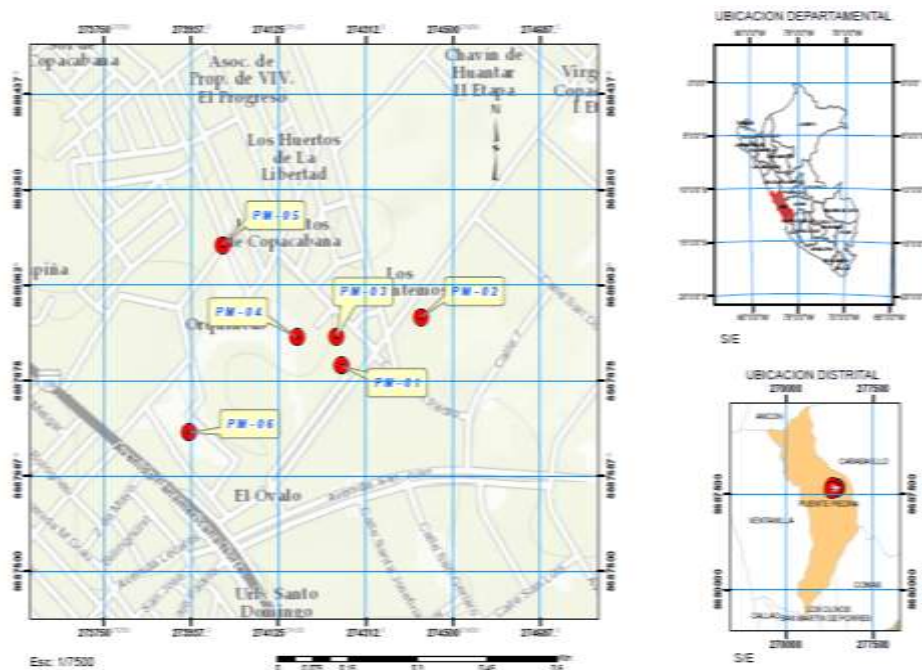


Figure 1. monitoring point of the study
Source: Obtained by ArcGis 10.3, 2017

The registered cases of acute respiratory infections in children under 5 years of age were obtained from the General Directorate of Integrated Health Networks - North Lima.

To obtain the concentration of nitrogen dioxide, palm tubes were prepared with triethanolamine and then collected. Then they were placed inside a container so that there is no alteration in the concentration of the contaminant. After seven days of exposure, the tubes were collected and exchanged for new prepared tubes. They were then taken to the laboratory for analysis.

3. Results and discussion

In order to determine the concentration of nitrogen dioxide and its incidence in acute respiratory infections in children under 5 years of age, the linear regression and correlation curve for the nitrogen dioxide concentration variables and the recorded cases of acute respiratory infections in children under 5 years of age were performed.

Table 1. Weekly summary of nitrogen dioxide concentration, cases of acute respiratory infections and ambient temperature

N° Week	Concentration NO ₂ (µg/m ³)	N° ARIs cases	Temperature (°C)
1	42.13	12	17.59
2	42.23	11	17.23
3	42.41	25	16.76
4	41.63	17	16.28
5	42.33	42	14.03
6	41.50	15	16.82
7	42.42	30	15.97
8	42.17	25	16.44
9	42.47	32	16.98
10	42.66	28	16.88
11	41.37	41	16.86
12	41.91	19	16.96

Weekly average nitrogen dioxide concentration was obtained, recorded cases of acute respiratory infections. Where the maximum value was recorded in week 10 for NO₂ concentration with 42.66 µg/m³, Number of cases of IRAs in week 35 with 42 cases recorded.

High and low ARIs were classified by type. Where in High ARIs, Pharyngitis had the highest number of registered cases (7 cases); in Low ARIs, Bronchitis has the highest number of registered cases (9 cases).

Table 2. Tipology Resume of ARIs in children less than 5 years

Tipology of IRAs	Number of ARI	Week				
		31	32	33	34	35
	Common Cold	1	1	2	2	4
High IRAs	Faringitis	2	2	5	2	7
Pharyngitis	Tonsillitis	2	3	3	2	5
	Laryngitis	1	2	2	3	5

	Otitis	1	0	1	1	4
	Sinusitis	1	0	2	1	3
Low IRAs	Bronchitis	3	1	6	3	9
	Pneumonia	1	2	4	3	5
	Total	12	11	25	17	42

Source: Red de salud Lima Norte IV – epidemiología, July - August 2017

From the following table, the linear regression between the variables nitrogen dioxide concentration and the cases of acute respiratory infections results in the following R2: 0.743 → 0.743*100 = 74.3%, which indicates the percentage that will influence the concentration of nitrogen dioxide on the registered cases of acute respiratory infections.

Table 3. Linear regression between nitrogen dioxide concentration and cases of Acute Respiratory Infections

	Sig. change in F	,000
Change statistic	GI2	10
	GI1	1
	Change in F	28,905
	Change in square R	,743
	Typ. Estimation error	5,53583
	Corrected square R	,717
	R square	,743
	R	,862
	Model	1

In the correlation curve an upward straight line is shown as an indicator of a positive correlation.

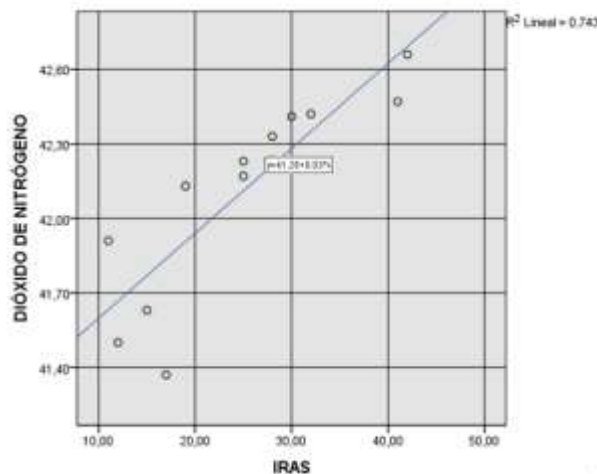


Figure 2. Correlation curve of Nitrogen dioxide concentration and recorded cases of Acute Respiratory Infections

4. Conclusions

According to the results obtained, the following conclusions can be drawn:

- The result obtained from the Pearson correlation, it was obtained that the temperature has a negative moderate relation with the low ARIs in children under 5 years, having as results bronchitis and pneumonia of -0.577 and -0.682 respectively.
- The statistical result of correlation, it was obtained that the concentration of nitrogen dioxide has a strong positive relation with the cases of low ARIs in children under 5 years old. The result is 0.862 .
- From the results obtained, it could be inferred that the variation of NO_2 concentration varies in 41 cases of acute respiratory infections, which could conclude that there is a strong positive correlation of nitrogen dioxide concentration with cases of acute respiratory infections in children under 5 years, which will influence 74.3% on cases of ARIs.

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