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Atmospheric Pollution in Dakar (Senegal) from 2011 to 2016: Correlation with the Prevalence of Respiratory Manifestations

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Abstract

Air pollution has a major impact on respiratory health. We conducted this study with the aim of correlating the levels of pollutants measured by the AQMC with the different respiratory manifestations reported in health facilities in Dakar (Senegal). Descriptive and analytical cross-sectional study conducted in Dakar from 2011 to 2016 to correlate pollution levels with respiratory manifestations. During the six years, 342203 patients were received for respiratory manifestations of which 61.81% had upper airway disease. Cough related or preceded by a cold predominated among the lower respiratory manifestations with 42.49% of cases. Peaks of gaseous pollution were consistently noted in the first and last quarters of each year. The prevalence of respiratory manifestations was strongly correlated with pollutant levels. Air pollution is permanent with peaks during the dry season. It has a negative impact on respiratory health. This justifies the need for multisectoral policies at different scales of decision.

Keywords: Gas pollution; Respiratory health; Asthma; Sulfur-dioxide; Nitrogen-dioxide

Introduction

Pollution of the atmosphere is a vast group of many gas molecules and particles, size and side effects variable. The range of effects of air pollution on health is wide, but it is mainly the respiratory and cardiovascular devices that are affected. According to World Health Organization (WHO) estimate, in 2012 air pollution caused the untimely death of 7 million people around the world [1]. It is considered a factor of exacerbation of chronic respiratory diseases such as chronic obstructive pulmonary disease (COPD), asthma, sinusitis and rhinitis. It can also cause new respiratory manifestations such as acute bronchitis, angina, pneumonia and/or bronchopneumonia, etc., [2,3]. According to the WHO the rate of air pollution in Dakar exceeds 7 times the pollution rates allowed in international standards in March 2015 [4]. In order to provide relevant, accessible and extensive information about acute effects of air pollution, we conducted a study to correlate the level of gaseous air pollution with the different respiratory manifestations reported in the various health structures of Dakar (Senegal) from 2011 to 2016.

Material and Methods

Study design and data analysis

This is a descriptive and analytical cross-sectional study, conducted in Dakar (Senegal) to correlate respiratory manifestations carbonated pollution levels (NO_2, CO_2) measured in the same period. Over a period of 6 years, we proceeded to the consecutive and exhaustive recruitment of all admitted patients in 29 of the 76 health districts of Dakar (Senegal) for respiratory signs outside any cardiovascular, digestive or traumatic pathology. The acquisition and analysis of the data was carried after the approval of the Division (Ministry of Health and Social Action) and the Air Quality Management Center (AQMC). The data collected included the health data and levels of gaseous pollutants according to time of year.

Choice of health districts

The selected health districts met the following criteria:

A sufficiently important consultation activity;

A health station official to join the surveillance;

Availability of health personnel (existence of substitute in case of absence);

An accessibility of the sites to the population with an easy transport;

Access to telecommunication networks (telephone and internet);

Good organization of the site with regular mailing of health data (monthly report) to the Ministry of Health and archiving and good record keeping.

Collection of health data

It was made to the ISI. It concerned all respiratory syndromes monitored. It was about:

- Cough tied or preceded by a cold;
- Acute or chronic bronchitis;
- Asthma;
- Acute low respiratory infection;
- Angina;
- Other manifestations such as Sinusitis, Allergic rhinitis and Nasopharyngitis.

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Collection of data relating to air pollution

Measurements of pollution peaks are obtained thanks to the five (5) fixed stations across the city of Dakar (urban station, suburban station, suburban station, industrial station, regional station) put in place by the AQMC, inaugurated on March 17, 2010.

Each station performs a daily measurement of gaseous and particulate pollutants. We were interested in the 2 air pollution indicators that are sulphur-dioxide (SO_2) and nitrogen dioxide (NO_2).

Statistical methods

The statistical analyses were performed using SPSS (Statistical Package for Science Socials) Version 18. The qualitative variables were compared using the chi-square test or Fisher's exact test (as appropriate). The time series were performed followed by a correlation test. A value of $p<0.05$ was considered statistically significant.

Results

Prevalence of respiratory manifestations

During the 06 years (2011 to 2016), 342203 patients had consulted for a respiratory symptomatology. Upper respiratory diseases predominated with 62.81%. Low respiratory diseases were dominated by coughing or preceded by a cold with 42.49% (n=145402). Figure 1 report the prevalence of respiratory manifestations. All respiratory symptoms gradually increased over time, especially during the last 3 years (2014-2016). Figure 2 report the temporal prevalence's of respiratory manifestations.

Correlation between respiratory manifestations and gas pollution

SO_2 exposure was correlated with respiratory events during the six years with statistically significant thresholds and positive correlation coefficients (Table 1).

The correlation between respiratory symptoms and exposure to NO_2 during the six years was statistically very significant for all respiratory manifestations (Table 2).

Discussion

The link between respiratory symptoms and atmospheric pollution has known, but not the effects of specific air pollutants [3,5,6]. We present a description of the different respiratory manifestations listed in 29 health facilities in Dakar from January 2011 to December 2016. Subsequently, we correlated them to gaseous pollution levels. This study was conducted in collaboration with the Ministry of Health and Social Welfare through the ISI and the Ministry of the Environment and Sustainable Development *via* AQMC.

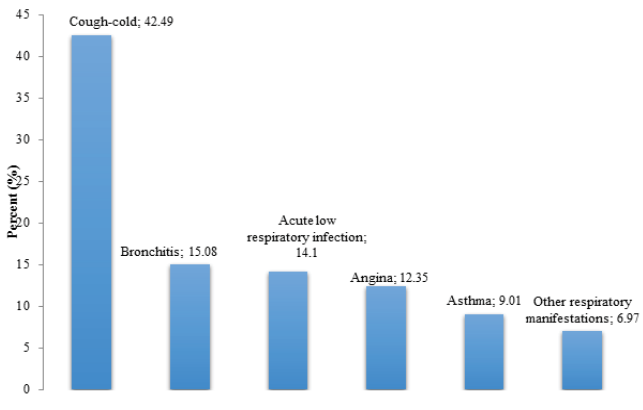

Figure 1 : Different respiratory syndromes detected in the Health Districts of Dakar (Senegal) from 2011 to 2016.

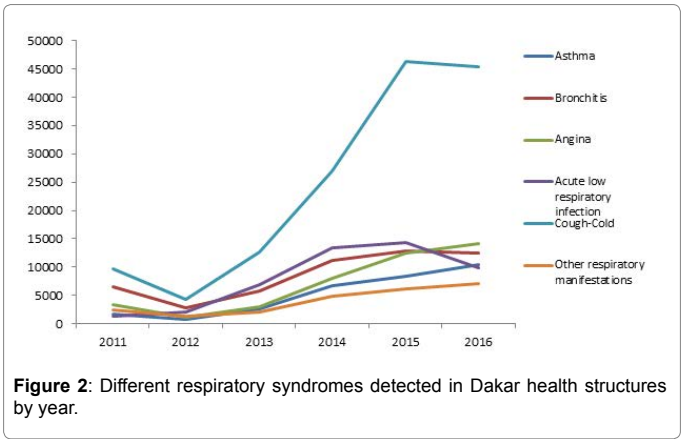

Figure 2: Different respiratory syndromes detected in Dakar health structures by year.

Respiratory manifestations	SO_2	
	Correlation coefficient	p-value
Angina	0.326	0.005
Bronchitis	0.372	0.001
Asthma	0.372	0.001
Other respiratory manifestations	0,345	0.003
Acute low respiratory infection	0,263	0.026
Cough – Cold	0,314	0.007

Table 1: Tests Correlation statistics between respiratory symptoms and SO_2.

Respiratory manifestations	NO_2	
	Correlation coefficient	p-value
Angina	0.348	0.003
bronchitis	0.277	0.019
Asthma	0.326	0.005
Other respiratory manifestations	0.326	0.005
Acute low respiratory infection	0.305	0.009
Cough - Cold	0.383	0.001

Table 2: Tests statistical correlation between respiratory symptoms and NO_2.

Prevalence of respiratory manifestations

We included during the 6 years all cases of respiratory diseases reported in the 29 health facilities in Dakar regardless of sex, age group, occupation, address and standard of living. They numbered 342,203. These results show the frequency of respiratory diseases in Senegal, particularly in Dakar. These findings are underestimated because these 29 health structures do not cover the entire population of Dakar and some people do not declare themselves sick. The distribution according to the type of respiratory manifestations showed a predominance of the cough linked or preceded by a cold (Nasopharyngitis) and its prevalence oscillated over time. Angina was reported in 12.4% of cases. Our study corroborated the data in the literature by showing a predominance of upper respiratory diseases [7-9]. A confounding bias is possible when we know that cough is a symptom that can last up to six weeks after the complete cure of a cold. It can therefore be mistakenly related to another respiratory condition. It is a reflex defense mechanism and will be noted in all patients with respiratory diseases with inflammation of

the tussigenous zones.

The distribution of respiratory manifestations over time showed a gradual increase in the prevalence of different conditions, especially during the last two years. This shows a new phenomenon including air pollution. Nevertheless, is it responsible for increasing the prevalence of these conditions and is it the only one?

Correlation between respiratory manifestations and gas pollution

Gaseous NO_2 and SO_2 pollution was associated with all reported respiratory manifestations in a statistically significant way [10,11]. The increase in pollution levels was followed by an increase in the prevalence of all respiratory manifestations as the literature findings [7,8]. In Atlanta, it was [12,13] observed close links between the number of hospital consultations for respiratory disorders (chronic obstructive pulmonary disease, asthma, pneumonia, etc.) and the content of pollutants (O_3, NO_2 and CO) in the ambient air. According to Martenies et al. [14], 46% of asthma hospitalizations related to air pollution are due to NO_2 exposures. Two cohort studies [15,16] have compared enter children, an association between exposure to NO_2 and SO_2 gas and decline in lung function. These gases, present in the atmosphere enter the body by inhalation. When inhaled, they will cause local inflammatory reactions that explain the high and low respiratory diseases observed [17]. The multiplicity of studies [18,19] makes it possible more and more to establish the relationship of cause and effect.

Conclusion

The analysis of the bibliographic data reveals the alarming level of pollution in our regions. This pollution is a risk factor for the exacerbation of chronic respiratory diseases such as asthma and Chronic Obstructive Pulmonary Disease. The imputability of this pollution is more and more specified by studies. The prevention of these diseases involves actions to fight against the spread.

Conflict of Interest

The authors declare there are no conflicts of interest.

References

1. Charpin D, Baden R, Bex V, Bladt S, Kadouch CC, et al. (2011) Environmental home inspection services in Western Europe. Environ Health Prev Med 16: 73-79.
2. Alan A, Dave MS (2011) Health effects of outdoor air pollution, approach to counseling patients using the Air Quality Heath Index. Can Fam Physician 57: 881-887, e280-287.
3. Simon I, Charpin D (2010) Respiratory symptoms and atmospheric pollution and respiratory symptoms in the general population. Rev Mal Respir 27: 625-638.
4. World Health Organization, Occupational and Environmental Health Team (2006) Air quality guidelines for particulate matter, ozone, nitrogen dioxide and sulfur dioxide: global update 2005 : summary of risk assessment. Geneva : World Health Organization.
5. D'Amato G, Vitale C, Lanza M, Molino A, D'Amato M (2016) Climate change, air pollution, and allergic respiratory diseases: an update. Curr Opin Allergy Clin Immunol 16: 434-440.
6. Epton MJ, Dawson RD, Brooks WM, Kingham S, Aberkane T (2008) The effect of ambient air pollution on respiratory health of school children: a panel study. Environ Health 7: 16.
7. Gning I (2011) Influence of air pollution on the occurrence of respiratory pathologies in sandaga traders and security guards at hotel meridien president in dakar. Thesis doct Pharma.
8. Pouye (2011) Prevalence of certain respiratory diseases in the Dakar region: correlation with the level of atmospheric air pollution. Thesis doct Pharma.
9. Tsabouri S, Bleta AG, Nastos PT, Priftis KN (2015) Ambient Environmental risk factors for childhood wheezing illness. Front Biosci 7: 447-468.
10. Gouveia N, Junger WL, ESCALA investigators (2018) Effects of air pollution on infant and children respiratory mortality in four large Latin-American cities. Environ Pollut 232: 385-391.
11. Idavain J, Julge K, Rebane T, Lang A, Orru H (2019) Respiratory symptoms, asthma and levels of fractional exhaled nitric oxide in schoolchildren in the industrial areas of Estonia. Sci Total Environ 650: 65-72.
12. Penard-Morand C, Charpin D, Raherison C et al. (2005) Long- term exposure to air pollution related to respiratory and allergic health in schoolchildren. Clin Exp Allergy 35: 1279-1287.
13. Wang S, Li Y, Niu A, Liu Y, Su L, et al. (2018) The impact of outdoor air pollutants on outpatient visits for respiratory diseases during 2012-2016 in Jinan, China. Respir Res 19: 246.
14. Martenies SE, Milando CW, Williams GO, Batterman SA (2017) Disease and Health Inequalities Attributable to Air Pollutant Exposure in Detroit, Michigan. Int J Environ Res Public Health 14: 1243.
15. Dales R, Chen L, Frescura AM (2009) Acute effects of outdoor air pollution on forced expiratory volume in 1s: a panel study of school children with asthma. Eur Respir J 34: 316-323.
16. Just J (2011) Impact of pollution on early childhood asthma. Rev Fr Allergol 51: 144-147.
17. Li X, Zhang X, Zhang Z, Han L, Gong D (2019) Air pollution exposure and immunological and systemic inflammatory alterations among schoolchildren in China. Sci Total Environ 657: 1304-1310.
18. Shima M (2017) Health effects of air pollution: a historical review and present status. Nihon Eiseigaku Zasshi 72: 159-165.
19. Tajudin MABA, Khan MF, Mahiyuddin WRW, Hod R, Latif MT, et al. (2019) Risk of concentrations of major air pollutants on the prevalence of cardiovascular and respiratory diseases in urbanized area of Kuala Lumpur, Malaysia. Ecotoxicol Environ Saf 171: 290-300.