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Relationship between Air Pollution Index (API) and Crowd Health in Nanchang City

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Abstract

Objective: To explore the effect of Air Pollution Index (API) on people's health. Methods: The data on air pollution index (API), NO_2, SO_2 and PM_{10} were based on the everyday monitoring information from environmental monitoring station of Nanchang City. The everyday outpatient service diseases information of 2005 related to air pollution from some First Level Hospitals in Nanchang city was collected, and was summarized and analyzed by statistics software of Excel 2003 and SPSS11.5. Results: The average concentrations of NO_2, SO_2 and PM_{10} in the air of Nanchang city from 2006-2009 were 19.70 ± 8.56 μg/m³, 44.60 ± 10.45 μg/m³, 62.30 ± 19.76 μg/m³ respectively. Tight relationship was detected between NO_2, SO_2 and PM_{10}. Air pollution index (API) can better reflect the air pollution status of Nanchang city. There were positive correlations between API and number of outpatient service diseases, including cardiovascular disease, respiratory disease, ophthalmology disease and ear-nose-throat (ENT) disease in Nanchang city. Conclusion API was related to the number of outpatient service relative diseases.

Keywords

Air Pollution Index (API), Disease, Number of Outpatient Service Diseases

1. Introduction

Atmospheric particulate matter (PM) is a complex mixture of elemental and organic carbon, ammonium, nitrate, sulphate, mineral dust, trace elements, and water [1]. PM, esp. PM_{10} (particulate matter with an aerodynamic diameter smaller than 10 mm) plays an important role in air pollution for its effects on human health and on the environmental behaviour [2]. It was further reported that as a main kind of pollutant, PM_{10} not only played an important role in climate change for its reduction of visibility [3], but also was associated with an increase of morbidity and mortality related to cancer, reproductive, respiratory and cardiovascular diseases [4].

Since the year 1999, NO_2 and PM_{10} have been reported in Environmental Bulletin in place of NOx and TSP in major cities like Beijing of China [5]. Urban residents have been demanding to improve air quality as the Chinese Government has established air quality monitoring sites in nearly every city, providing the public with detailed information regarding air condition and daily air pollution index (API). Residents express more concerns

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about air quality in their cities [6].

Air pollution index (API) data have been extensively used in studies on air pollution in China [7] [8], based on a network of multiple monitoring stations, which represent different zones (industrial, commercial, traffic and residential) and the suburban background. Five designated pollutants: PM_{10}, SO_2, NO_2, CO and O_3 (in some cities three pollutants were collected: PM_{10}, SO_2 and NO_2) are measured [7].

API is a simplified figure that joins the several kinds of air pollutant concentration by conventional monitoring into a single concept numerical form, and hierarchically represents air quality status and the degree of air pollution. The result of the index (API) can directly conveniently describe the air quality in a city within a designated period of time. Calculating API sub-index (sub-API) of each pollutant, the biggest sub-API of all kinds of pollutants in the pollution is the city's air pollution index of the day (API), and the corresponding pollutant with the biggest sub-API is identified as the principal pollutant for the city [7]. That is to say, every day air pollution index API of city represents the primary pollutant of that day.

In 2003, as the primary pollutant in Nanchang city, PM_{10} accounted for more than 80%. In 2004 and 2005, PM_{10} accounted for more than 90%. PM_{10} has become the characteristics of air pollution contaminants in Nanchang city, SO_2 is in the second place [9].

More reports are based on atmospheric particulates to study the respiratory system and cardiovascular system diseases [4] [10], but the relationship research between air pollution index (API) and related disease was less than rare. In order to further discuss the air pollution characters and potential hazard in Nanchang city, the main parameters of the city air pollution and outpatient service visits of related diseases were collected and analyzed statistically.

2. Material and Methods

The API of 2005 and the data of NO_2, SO_2 and PM_{10} of 2006-2009 in the air of Nanchang city were from the daily report of Jiangxi Meteorological Bureau, the daily monitoring data provided by Environmental Monitoring Station of Nanchang City. The visit of outpatient service diseases related to air pollution in 2005 was investigated retrospectively from a First-Level hospital in Nanchang city, *i.e*. the daily outpatient service medical material in the whole year of 2005 was collected. At first the cases of outside Nanchang city were eliminated according to the family addresses on medical record, then the diseases related to air pollution were classified and analyzed by statistics software of Excel 2003 and SPSS11.5 based on the registered disease species, such as cardiovascular disease, respiratory disease, ophthalmology diseases, ENT diseases, dermatology diseases, etc. Relationships between API and various diseases were established, the correlation analysis of linear regression was processed, and the effect on human health from air pollution was comprehensively evaluated.

3. Result and Analysis

3.1 Mutual Relations among NO_2, SO_2 and PM_{10} in the Air of Nanchang

Between January 9, 2006 and October 3, 2009, the data of NO_2, SO_2 and PM_{10} of 361 days were collected from 9 atmospheric monitoring spots of Nanchang city. The average values of NO_2, SO_2 and PM_{10} were 19.70 ± 8.56 μg/m^3, 44.60 ± 10.45 μg/m^3, 62.30 ± 19.76 μg/m^3 (see **Table 1**), which were far lower than the concentrations of air pollution of Jinan city of China, NO_2 42.1 ± 25.8 μg/m^3, SO_2 59.9 ± 61.7 μg/m^3, PM_{10} 140.6 ± 71.6 μg/m^3, respectively [11]; there were relations among them (see **Table 2**). The above results indicate that the API constitutes the primary daily pollutant of the city and can well reflect the local air pollution condition of Nanchang.

3.2. Effect on Hospital Visits of Cardiovascular Disease from API

From January 1 to December 31 in 2005, the daily hospital visits of cardiovascular disease were 67 - 317 cases,

Table 1. Air quality monitoring results of 2006-2009 in Nanchang city (unit: μg/m^3).

Detection items	Minimum	Maximum	Mean	Standard deviation
NO_2	7.00	59.00	19.70	8.56
SO_2	22.00	79.00	44.60	10.45
PM_{10}	5.00	139.00	62.30	19.76

the mean of which was 144.92 ± 37.91 cases. API's influence on the hospital visits of cardiovascular disease and its correlation were shown in **Figure 1**, F = 6.174, R^2 = 0.0168, R = 0.13, P = 0.013 < 0.05, the relationship between API and hospital visits of cardiovascular disease was closely related (positive correlation). These results are similar to those observed in other studies [12] [13], which showed the effect of ambient air pollution on hospital admissions of circulatory system diseases and daily cardiovascular mortality.

3.3. Effect on Hospital Visits of Respiratory Disease from API

Between January 1, 2005 and December 31, 2005, the daily hospital visits of respiratory disease were 0 - 279 cases, and the mean was 77.02 ± 38.21 cases. API's influence on the hospital visits of respiratory disease and its correlation showed in **Figure 2**, F = 4.247, R2 = 0.0116, R = 0.11, P = 0.040 < 0.05, API was closely related to hospital visits of respiratory disease (positive correlation), which was consistent to the research result of Wang Yan [11], showing the effect of air pollution on the daily hospital visits of respiratory disease.

Table 2. Relationship among NO_2, SO_2, PM_{10}.

Items	Regression equation	R^2	F	P
NO_2, SO_2	Y = 0.8317x + 28.2260	0.466	308.164	<0.01
SO_2, PM_{10}	Y = 1.2236x + 7.7476	0.419	256.860	<0.01
NO_2, PM_{10}	Y = 1.3234x + 36.2690	0.330	174.297	<0.01

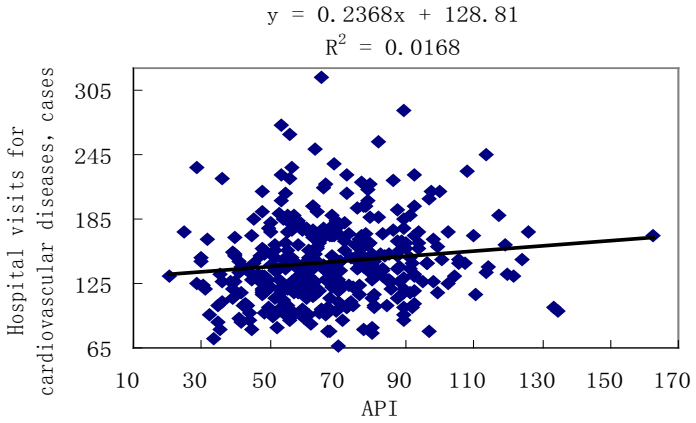

Figure 1. Relationship between API and hospital visits for cardiovascular diseases.

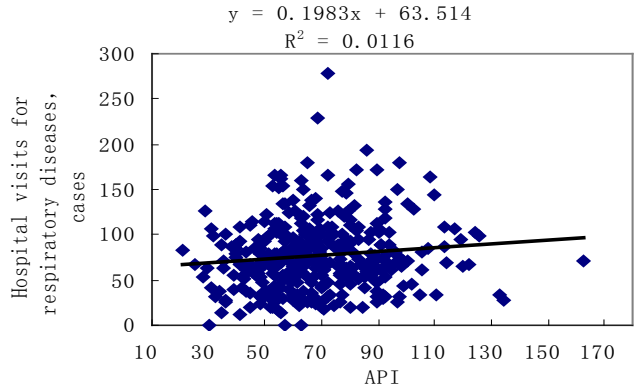

Figure 2. Relationship between API and hospital visits for respiratory diseases.

3.4. Effect on Hospital Visits of Ophthalmology Disease from API

Between January 1, 2005 and December 31, 2005, the daily hospital visits of ophthalmology disease were 10 - 282 cases, the mean was 124.38 ± 51.20 cases. API's influence on the hospital visits of ophthalmology disease and its correlation showed in **Figure 3**, F = 5.145, R^2 = 0.0141, R = 0.12, P = 0.024 < 0.05, API was positively correlated to hospital visits of ophthalmology disease.

3.5. Effect on Hospital Visits of ENT Disease from API

Between January 1, 2005 and December 31, 2005, the daily hospital visits of ENT disease were 13 - 343 cases, and the mean was 169.15 ± 67.10 cases. API's influence on the hospital visits of ENT disease and its correlation was shown in **Figure 4**, F = 4.362, R^2 = 0.0121, R = 0.11, P = 0.037 < 0.05, API was positively correlated to hospital visits of ENT (ear-nose-throat) disease.

3.6. Effect on Hospital Visits of Dermatology Disease from API

Between January 1, 2005 and December 31, 2005, the daily hospital visits of dermatology disease were 0 - 202 cases, and the mean was 99.94 ± 40.15 cases. API's influence on the hospital visits of dermatology disease and its correlation was shown in **Figure 5**, F = 2.055, R^2 = 0.0058, R = 0.076, P = 0.153 > 0.05, and the relationship between API and the hospital visits of dermatology disease was not evident.

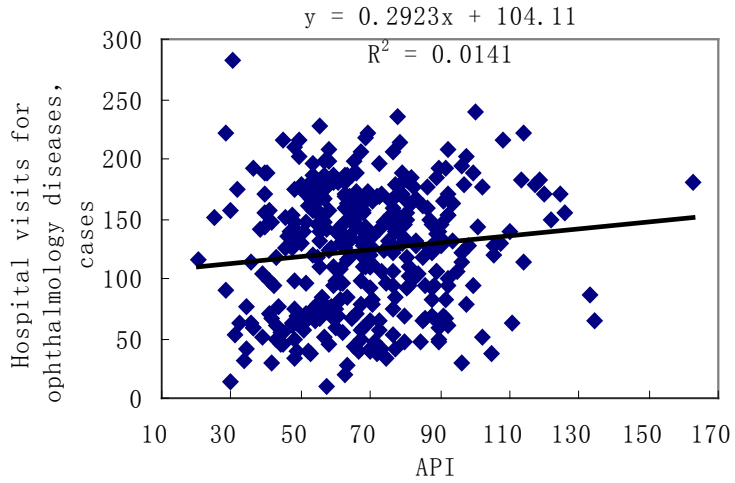

Figure 3. Relationship between API and hospital visits for ophthalmology diseases.

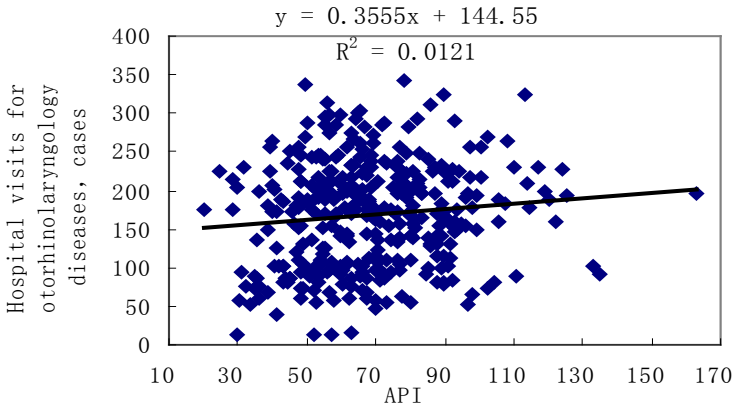

Figure 4. Relationship between API and hospital visits for otorhinolaryngology diseases.

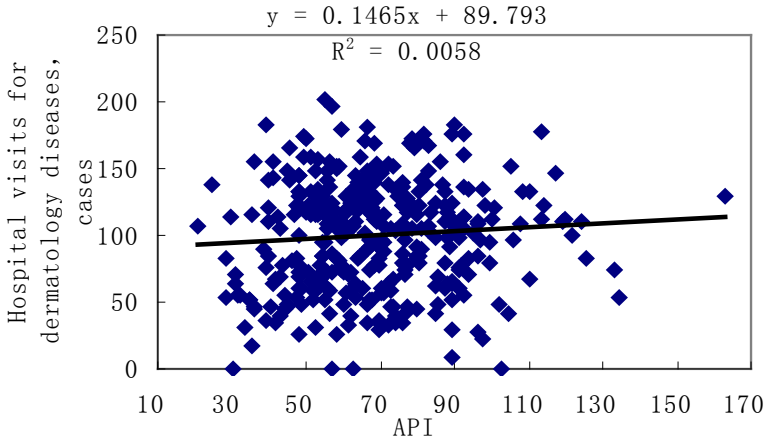

Figure 5. Relationship between API and hospital visits for dermatology diseases.

4. Conclusions

The average concentrations of NO_2, SO_2, PM_{10} from 2006-2009 were 19.70 ± 8.56 μg/m^3, 44.60 ± 10.45 μg/m^3, 62.30 ± 19.76 μg/m^3. There were closely relations among NO_2, SO_2 and PM_{10}. The urban air pollution index (API) with daily primary pollutants as the foundation can well reflect the local air pollution condition.

The API of Nanchang city is closely related to the daily hospital visits of cardiovascular diseases, respiratory diseases, eye diseases and ENT diseases (positive correlation), but not related to the hospital visits of dermatology disease. The above research about the relationship between API and hospital visits of related diseases, such as cardiovascular diseases, respiratory diseases, eye diseases, ENT diseases and dermatology diseases, has not been reported before, so further in-depth study esp. about Pb pollution of $PM_{2.5}$ in the industry area and traffic lines will be necessary.

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