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Research Article

Study on Government Employees Concerns about Air Pollution and its Control in Nanchang, China

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Abstract

Air pollution has become an imminent hazard to public health in China. The government employees perceptions of air quality, pollution sources and the current policies are critical for air pollution control. A cross-sectional survey of 629 questionnaires to specifically targeted government employees was conducted between March and July of 2015. The aim of this paper is to assess the understanding of, and factors associated with the government employees' understanding of air pollution causes and the government's prevention policy in Nanchang. Survey results suggested that 39.5% of respondents felt anxious when exposed to contaminated air. A multivariable logistic regression model was used and declared that female and older adults were more anxious about current air pollution. Most of the respondents are aware of the three major causes of air pollution: motor vehicles (64.64%), industrial facilities (63.98%), and city development (53.78%). They also recognize the most effective method for air pollution control, namely national-wide control of air pollution (93.42%), increasing solar and other green energy (83.39%), and controlling current urban expansion (38.49%). In addition, about 72% of respondents believed that the local government did not spend enough on environmental protection, and 95.4% of respondents supported more government spending or action to improve air quality. A great majority of respondents thought the local leaders should place high priority on preserving and protecting the local environment. Our results suggest that local government should take quick action to implement effective regulations and laws for controlling air pollution during the fast growing industrialization development.

Keywords: Air pollution; Perception; Government employee; Nanchang; Environmental protection

Introduction

Rapid development of the economy and society over the past three decades has led China to be the world's second largest economy after the United States, but at the cost of serious environmental pollution [1,2]. China's inefficient model of economic growth, high resource commitment and resource consumption has caused serious environmental pollution, most notably air pollution [3]. The Asian Development Bank [4] report showed that seven of the ten most polluted cities in the world were located in China, endless than 1% of 500 major cities in China met the World Health Organization's air quality standards [5]. The World Bank report revealed that more than 60% of Chinese urban populations were exposed to the III standard or above air pollution [6]. Additionally, according to China Environmental Bulletin released on June 4, 2015, only 16 of 161 cities selected as the Nationwide New Air Quality Standard for testing met the new air quality standard, yielding an air quality compliance rating of less than 10% [7]. China is facing the most severe environmental challenges in its history, threatening the present and future generations' living conditions. If these environmental challenges are not addressed properly, poor air quality could affect the health of the Chinese population as well as China's economic development in the next decade.

Air pollution has caused tremendous health hazards [8,9]; several large epidemiological studies have shown it can increase morbidity and mortality [10,11]. Recent studies have revealed that air pollution is associated with many diseases such as respiratory diseases like Chronic Obstructive Pulmonary Disease (COPD), asthma, and lung cancer [12-16]. New health problems will appear if China continues to undergo urbanization without effective control policies. According to The 2010 Global Burden of Disease Report published in The Lancet, outdoor pollution caused by Particulate matter less than 2.5 micrometers in diameter (PM2.5) led to 1.2 million premature deaths and 25 million disability adjusted life years lost in China in 2010 [17,18]. Accordingly, it caused strong resentment among the people. This allows us to be keenly aware that economic development must not be to the cost of environmental pollution and economic development needs to protect the environment.

Since air pollution is a major public health problem in China, public meetings are held to ask the government to take action. As policy makers, government employees have an apparent impact on air pollution control. Government employees' awareness of the effects of air pollution will not only reflect how high a priority local governments place on air pollution but also impact the authority's governing philosophy profoundly. Government workers'accurate understanding of the sources of air pollution is crucial in developing campaigns and programs that address this issue, and which will affect the corresponding policy decision. We have recently examined

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parents' and caretakers' perceptions on how air pollution has affected their children's health in last two years [19,20]. Therefore, we followed Zhang et al.'s study this year, and our main focus is to understand how local government employees view the connection between air pollution and its health impacts and their perceptions of the sources of air pollution and control measurements.

Materials and Methods

Inclusion criteria

According to the Civil Servant Law of the People's Republic of China [21], we chose those government staffs in-service in Nanchang for the survey, including the contract workers, but office support personnel were excluded in this study.

Sample size estimation and sampling strategy

Sample size was determined by the formula of the cross-sectional survey [22]:

Where π is the overall awareness rate 45.8%, from the result of Zhang et al., study [19], δ is the margin of error (5%). The level of significance is set at 5%, thus the z-value is 1.96 and the sample size is calculated to be 382.

Stratified cluster sampling was used to recruit participants. First, under full consideration of the economic situation of each district among the nine districts of Nanchang, we ranked them based on their per capita gross domestic product in 2013 (per capita GDP = the total GDP of a district / the resident population of the district), according to the data from the Jiangxi Statistical Yearbook 2014 [23]. These districts were then divided into high, medium and low groups and one district was randomly selected from each group: Donghu District was labeled as high-income, Qingyunpu District was selected for medium, and Wanli District enrolled for the low-income group. Finally, three different government departments were randomly chosen from each district, with nine departments selected in total. Taking into account non-response rate, we distributed 585 questionnaires to the nine departments (65 each). Additionally, 74 questionnaires were issued to the health and family planning commission of Donghu District and 75 were sent to the remaining eight departments. Thus, a total number of 629 questionnaires were issued.

Survey method

Based on the questionnaire used in the survey conducted among residents in Nanchang in 2013 (19), a 26-item questionnaire improved by public health experts from University of Hawaii at Manoa and Nanchang University was used. The questionnaire covers: 1) social demographic characteristics including the participant's gender, age, educational level, average annual household income (AAHI); 2) perception of current air quality, such as general attitude about local air quality, knowledge of air pollution index and concerns about health issues associated with air quality, etc. 3) understanding of the main sources of air pollution and its control measures; 4) perceptions about the individual and governmental actions aimed at air pollution management. Most questions utilized a 4 or 5-point Liker scale.

Quality control

Both the sample selection and the questionnaire survey for this study were carried out in strict accordance with the design plan. The investigators were trained to use a unified guidance language. The questionnaire survey was filled out independently by government employees themselves based on their understanding of the items, which can avoid bias due to induced prompts of investigators. To maximize the participants' compliance, we made a very clear explanation of the purpose and significance of this study to the investigation objects every time before the survey was conducted and patiently answered the questions raised by them. Investigators verified the questionnaires, and timely reworked unqualified questionnaires with obvious logic errors or omissions, or eliminated invalid and poor quality questionnaires (such as having the same answer for all questions and duplicate questionnaires). We used EpiData3.1 to set up the database, double entry and logical verification of the questionnaires was done to ensure the accuracy of the data.

Table 1: Sample demographics.

Demographic Factors	Frequency	Percentage (%)
Government employees' gender		
Male	419	68.91
Female	189	31.09
Government employees' age		
18-29	187	30.76
30-39	177	29.11
40-49	148	24.34
50-60	96	15.79
Government employees' educational level		
Junior high school	4	0.66
High school	28	4.60
Bachelor's degree	502	82.57
≥ Master's degree	74	12.17
Government employees' AAHI* (RMB)		
≤ 10,000	24	3.95
10,000-24,999	125	20.56
25,000-49,999	246	40.46
50,000-74,999	106	17.43
75,000-99,999	82	13.49
≥ 1000,000	25	4.11

*AAHI = Average Annual Household Income.

Statistical analysis

The data was analyzed using the Statistical Package for the Social Sciences (SPSS) version 17.0 and Microsoft Excel 2012. The alpha level was set at 0.05 to determine statistical significance. Descriptive statistics were used to summarize the characteristics of the participants, and multi-variate logistic regression analyses were performed to determine the factors that were associated with the participants' anxiety of contaminated air.

Results

General demographic characteristics of respondents are shown in Table 1. A total of 608 valid questionnaires were collected (recovery rate was 96.66%). There were 419 males (68.91%) among the respondents. Age at 18-29, 30-39, 40-49 and 50-60 accounted for 30.76%, 29.11%, 24.34% and 15.79% of the responses, respectively.

Table 2: The government employee's beliefs about the important of factors basing on their risk to our health in Nanchang.

Contents Importance	Most important n (%)	Important n (%)	Fair n (%)	Less important n (%)	Least important n (%)	Mean score
Air pollution	260(42.76)	76(12.50)	216(35.52)	52(8.55)	4(0.68)	3.88
Water pollution	117(19.24)	294(48.36)	137(22.52)	57(9.38)	3(0.49)	3.76
Food safety	193(31.74)	138(22.70)	202(33.22)	68(11.18)	7(1.14)	3.73
Drug safety	37(6.10)	88(14.47)	49(8.06)	423(69.57)	11(1.80)	2.53
Other	1(0.16)	12(1.97)	4(0.68)	8(1.32)	583(95.89)	1.09

Table 3: Factors that were associated with anxious feelings when exposed to contaminated air.

Characteristics	Anxious feelings				Crude Odds Ratio (OR)		Adjusted Odds Ratio (OR)	
	Yes		No		OR(95%CI)	P-value	OR(95%CI)	P-value
	n	%	n	%				
Gender								
Male	116	27.7	303	72.3	1		1	
Female	124	65.6	65	34.4	4.983(3.447-7.204)	<0.001	34.691(14.484-83.090)	<0.001
Age								
18-29	8	4.3	179	95.7	1		1	
30-39	45	25.4	132	74.6	7.628(3.479-16.722)	<0.001	4.945(2.038-11.995)	<0.001
40-49	100	67.6	48	32.4	46.615(21.210-102.450)	<0.001	142.317(46.823-432.563)	<0.001
50-60	87	90.6	9	9.4	216.292(80.673-579.894)	<0.001	1218.659(315.201-4711.686)	<0.001
Educational level								
≤ High school	29	90.6	3	9.4	1		1	
Bachelor's degree	194	38.6	308	61.4	0.065(0.020-0.217)	<0.001	0.523(0.120-2.269)	0.386
≥ Master's degree	17	23.0	57	77.0	0.031(0.008-0.114)	<0.001	0.602(0.113-3.207)	0.552
AAHI (RMB)								
≤ 24,999	61	40.9	88	59.1	1		1	
25,000-49,999	99	40.2	147	59.8	0.972(0.642-1.470)	0.891	1.198(0.651-2.205)	0.561
50,000-74,999	39	36.8	67	63.2	0.840(0.503-1.402)	0.504	0.599(0.239-1.498)	0.273
≥ 75,000	41	38.3	66	61.7	0.896(0.539-1.490)	0.673	1.130(0.451-2.835)	0.794
Total	240	39.5	368	60.5				

The vast majority of government employees (94.74%) achieved at least a bachelor's degree. A total of 246 respondents' Average Annual Household Income (AAHI) was between 25000 to 49999 Yuan, followed by AAHI between 10000-24999 Yuan, accounting for 40.46% and 20.56%, respectively.

Respondents' beliefs about the important of factors basing on their risk to our health are shown in Table 2. The total average scores of each factor was 3, and air pollution, water pollution, and food safety were considered to be the top three risks to our health by the government employees in Nanchang, accounting for the average scores of 3.88, 3.76, and 3.73, respectively (Table 2).

Among the 608 respondents, 240 (39.5%) felt anxious when exposed to contaminated air. The crude odds ratios (OR) obtained from bivariate logistic regression analyses and adjusted odds ratio from multivariable logistic regression model with the 95% Confidence Intervals (CI) and p-values were shown in Table 3. Bivariate analyses showed that participants' age, gender, and education level were found to be associated with their anxious feelings. However, education level did not appear to be significant factor in the multivariable analysis. We found that women were more likely to have anxious feelings as compared to men, with OR values of 4.983 (95%, CI 3.447-7.204); and those who were older than 29 years of age were more likely to feel anxious when exposed to the poor air quality.

As shown in Figure 1, most participants believed that the main air pollution sources in Nanchang were motor vehicles (393, 64.64%), industrial facilities (389, 63.98%), and city development (327, 53.78%). There were also 230 (37.83%) respondents that thought waste burning was one of the polluters of air quality. Figure 2 reveals that most respondents supported the government taking preventive measures to improve air quality in Nanchang through a nation-wide control of air pollution (93.4%) and increasing solar and other green energy (83.4%), And the third important measurement is controlling and slowing down current city development (38.5%). However, only 82 and 76 participants believed that increasing public mass transportation to reduce the number of cars and controlling industrial facilities based air pollution were more essential, accounting for 13.5% and 12.5%, respectively.

Table 4 shows that 436 respondents (71.7%) considered the

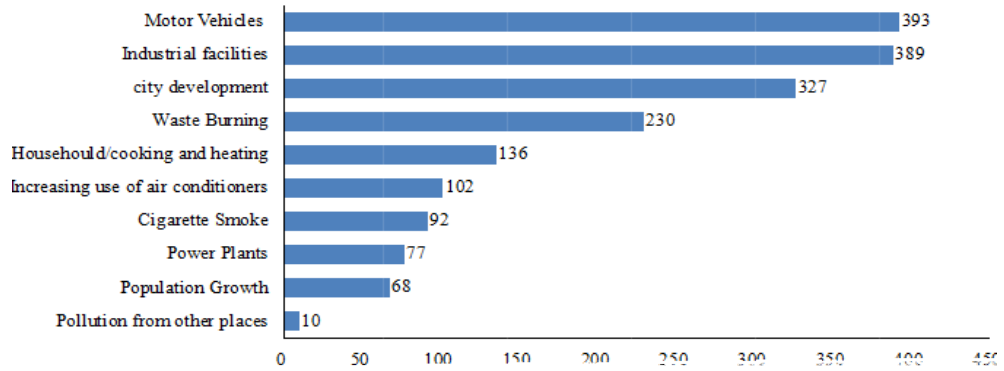

Figure 1: Participants' beliefs about the three most serious sources of air pollution in Nanchang.

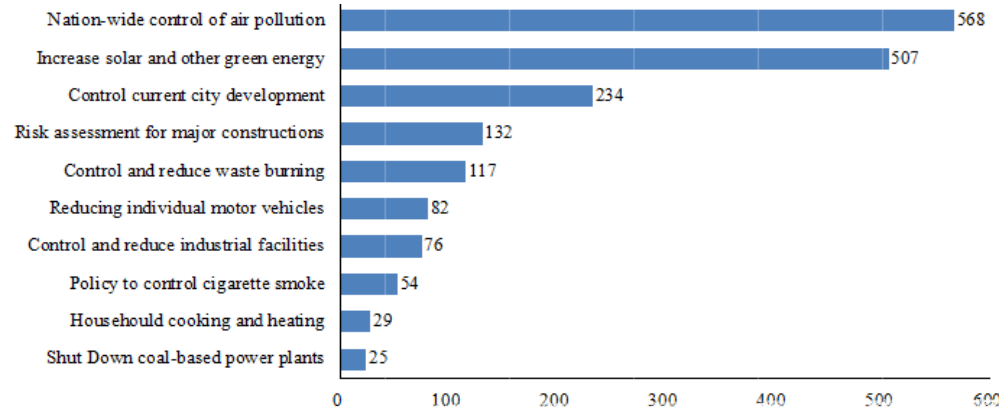

Figure 2: Participant suggestions: top three areas needing more attention from the government.

Table 4: Participants attitudes towards government policies supporting air quality improvement.

	Frequency	Percentage (%)
Responsibility for every citizen		
Strongly Agree	362	59.6
Agree	233	38.3
Undecided	11	1.8
Disagree/Strongly Disagree	2	0.3
More government spending/action		
Strongly support	329	54.1
Support	251	41.3
Undecided	27	4.4
Oppose/Strongly oppose	1	0.2
How high a priority place on this issue		
Very high priority	344	56.6
High priority	239	39.3
Mid-level priority	24	3.9
Low priority/Very low priority	1	0.2
Amount of resources spends on improving		
Way too much/A bit too much	93	15.3
The right amount	79	13.0
Not quite enough	325	53.4
Way too little	111	18.3

amount of resources the Nanchang government has currently spent on local environmental protection was insufficient and 580 respondents (95.4%) supported more governmental spending and action to improve air quality. As summarized in (Table 4), almost every individual respondent supported the government to consider air quality improvement as a job of high priority. In addition, almost all respondents agreed that improving the air quality is the responsibility of every citizen.

Discussion

Air quality is closely related to people's health and lives, and clean air is a basic requirement for human health. Air pollution related health issues are catching people's attention at an increasing rate in China. However, with the rapid growth of the Chinese economy, many cities in China today are facing poor air quality because of an increase in energy consumption, electricity generation, and increased motor vehicle use which is leading to increase in multiple pollutant emissions [24-26] and has adversely affected the life quality of residents [27,28]. More than three-quarters of the urban population is exposed to air that doesn't meet the national ambient air quality standards of China [29]. In order to prevent and control the atmospheric pollution, protect public health, and promote social and economic sustainable development, the Ministry of Environmental Protection of the People's Republic of China has recently used television and other mediator strengthen publicity to raise public awareness and attention of air quality. Since the government employees' perceptions of air quality are critical for designing appropriate intervention measures or policies to improve the air quality [30], government employees in Nanchang were specifically selected for our study.

In this study, we sought to understand what the government

employees believed to be the main cause of air pollution in Nanchang. Asian Development Bank [4] released a report stating that most of the contaminants were from industrial point source emissions and vehicle emissions. As the capital of Jiangxi province and one of the China's biggest modern manufacturing center, Nanchang is located in the center of southeastern China with a population of over 5.24 million [31] and its economic gross relies mainly on industry. Recently, with the rapid urban redevelopment such as ongoing subway construction projects, demolition projects of older buildings and construction of new buildings, and industrial park expansion projects and new industrial construction projects, it has led to an increased level of air pollution. Motor vehicle exhaust emissions have also contributed to current air pollution because of the low gasoline quality, engine exhaust, tail gas treatment, and gas station emissions caused by automobile traffic. In the urban area of Nanchang, the distribution of energy use showed that 70% of the energy source is coal and 15.7% is gasoline [32]. This indicated that the actual air pollution source in Nanchang is the current energy structure.

Results from our study showed that the top three sources of air pollution in Nanchang perceived by local government employees were motor vehicles, industrial pollution, and residential development. These findings are very consistent with objectively-measured air pollution in Nanchang. This finding indicates that the local government employees' understanding of the sources of air pollution is quite accurate. So it may be helpful for the government to accurately and effectively control the pollution sources. Our finding suggests that adjustment of current industrial structure would be the most effective and essential measures to solve and reduce the emission of pollutants at its source by adjusting the industrial structure, which not only can effectively control the emissions of particulate matter, but also significantly reduce emissions of sulfur dioxide, nitrogen oxides and other pollutants. For controlling vehicle exhaust, it is necessary to strengthen the management and construction of the road, and it is recommended to prohibit excessive vehicle use and phase out high polluting vehicles. The government should also implement urban green ecological engineering, establish urban forest system, and strengthen construction site management.

However, it is interesting to note that in terms of how to control air pollution, our survey results show that most government employees think that the government should take preventive measures to improve air quality in Nanchang by nation-wide control of air pollution (93.4%), increasing solar and other green energy (83.4%), and controlling and slowing down current city development (38.5%). Few participants believed that increasing public mass transportation to reduce the number of cars and controlling industrial facilities based air pollution were more essential. There are some inconsistencies with previous knowledge of the sources of air pollution. The reasons why the respondents do not want to reduce the number of cars and controlling and reduce industrial facilities might be due to the conflict of interest. In fact, most government employees in Nanchang own at least a motorcycle or a car and use them routinely, and the development of industry will bring Gross Domestic Product (GDP) growth and the local government believed that reducing industrial facilities will slow economic growth.

Furthermore, participants were asked how they feel about current government actions on environmental protection. It seems that governmental efforts currently placed on environmental protection are not enough. Survey results showed that 436 respondents (71.7%) considered that the amount of resources the local government has currently spent on environmental protection was insufficient and 580 respondents (95.4%) support more governmental spending and action to improve air quality. Almost everyone supported the government to consider improvement of air quality to be a very high priority (56.6%) or a high priority (39.3%), and 3.9% considered it should be listed at least mid-level priority. In addition, almost all respondents agreed that improving the air quality is the responsibility of every citizen. Those findings are important in moving the social dilemma from the governmental stuffs' perspective to affect the implementation of related policies. Local governments should put forward specific requirements to strengthen its efforts towards preventing and controlling air pollution measures, including industrial air pollution control, high-pollution fuel combustion zone ban pollution control, dust pollution prevention and remediation, motor vehicle exhaust pollution control, and air pollution control in suburbs.

Conclusion

This survey study shows that local government employees considered the important factors based on their risk to health in Nanchang is air pollution. 39.5% of respondents felt anxious when air quality is poor, especially females and the elderly. The local government employees' understanding of the sources of air pollution is quite accurate and the main sources of air pollution in Nanchang were motor vehicles and coal emissions from industrial facilities. However, their suggestions for controlling air pollution have some inconsistencies with their knowledge of the sources of air pollution. Most government employees considered that the local air quality is poor and that the government has not put sufficient effort on solving the problem. Findings from this survey study support that effective policies should be introduced and relevant regulations and laws should be reformed. More financial support for air pollution control should be budgeted while promoting technological research and development. Relevant industries and energy agencies should also be restructured such as boosting innovation in production practices and limiting the consumption of coal so that the foundation of the improvement of air quality can be better laid.

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