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A Study and Analysis of Air Pollution in a Metropolitan City

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Abstract - Basically, there are two types of air pollutions, indoor and outdoor air pollutions, which are considered as the world's worst toxic pollutions. The main source of air pollution in recent years is due to automobiles, construction activities, industries, dust, and field burning. Air pollution exposure is recognized as an important contributor to premature mortality and morbidity globally. Exposure to ambient particulate matter smaller than 2.5 microns in aerodynamic diameter (PM2.5) has been associated with all-cause and non-accidental mortality, cardiovascular and respiratory diseases, premature births and birth defects, and neurocognitive deficits, among other conditions. The major air pollutants, which affect human health are sulphur dioxide (SO2), nitrous oxide (N2O), particulate matter (PM10), carbon monoxide (CO), suspended particulate matter (SPM), and ozone (O3). In any metropolitan city, the level of air pollution as well as its impact on public health is a deep concern as it affects a huge population. In the first phase of this research, the ambient air quality in the metropolitan city of Chennai has been studied to bring out the level of air pollution and thus create awareness among the public and the government agencies

Key Words: carbon monoxide, particulate matter, sulphur dioxide, suspended particulate matter.

1.INTRODUCTION

Global evidence indicates that ambient air pollution is a major public health hazard, with harmful associations being reported with respect to all-cause mortality (Di et al., 2017; Samet et al., 2000; Zanobetti & Schwartz, 2009), cause-specific mortality from cardiovascular (Dehbi et al., 2017; Yap et al., 2019) and respiratory diseases (Mokoena et al., 2019; Xue et al., 2018). The contamination of water, air or soil by substances that are harmful to living organisms causes pollution (Senthilnathan 2008; Davies et al 2011) . Human activities since preindustrial times have resulted in a large increase of air pollution.

2. Experimental Design

The response obtained from 513 respondents was analyzed using SPSS. The statistics obtained for different queries in the questionnaire are given in Appendix 4. The details of rating frequencies for different queries are given in Appendix3. Out of the total respondents about 11 % were traffic police, 43 % vendors and the rest 46 % were auto-drivers. The female respondents were only 8 % and all of them were vendors. Also the respondents from closed environment were about 12%. Out of the total respondents, about 78 % reported to have the symptoms of disease due to air pollution. The descriptive statistics on the items tested are presented in Table 4.6. The means shown are mean weighted scores on a rating scale of 1 to 5.

Item description	Mean	Standard deviation
1. Sources of emission contributing to air pollution		
Vehicle emission	3.59	1.284
Dust	3.10	1.275
Field burning	3.20	1.248
Construction activities	2.90	1.268
Industry	2.76	1.319
2. Factors affecting air pollution level due to		
Seasonality	3.03	1.151
Festivals	4.23	1.153
Time of the day	2.98	1.204
Traffic	3.66	1.193
3. Effect of pollution on human well-being Health		
Work	2.84	1.253
Sleep	2.64	1.264
	2.58	1.218
4. Extent of exposure to pollution	2.55	1.238

5. Decrease in air pollution due to introduction of new transport systems Mass rapid transport system (MRTS) Metro rail Bus rapid transport system (BRTS)	3.28 3.51 3.07	1.621 1.708 1.782

Table -1: Descriptive statistics

3.1 Sources of Contribution to Air Pollution

ANOVA and Tukey's test were used to determine the variables from the following, contributing to air pollution.

Vehicle emissions (A)

Dust (B)

Field burning (C)

Construction (D)

Industry (E).

From the SPSS output of frequency (Appendix 5), using the ratings given by the respondents (1-very low, 2- low, 3-moderate, 4-high and 5-very high), the weighted-score for various items in Appendix 5 was computed. Table 4.7gives the weighted score for all the sources contributing to air pollution.

Fig -1: Chennai City Map

3. RESULTS AND DISCUSSION

It was observed that seasonality, festivals, time of the day and traffic also affect the level of air pollution. The highest increase in air pollution was due to festivals, followed by vehicle traffic. During festivals excessive field burning (Bogie) and smoke due to firing of crackers (Deepavali) cause excessive increase in air pollution. In spite of the warning by the government to prevent these things, they continue to happen. More public awareness should be created on the ill effects of air pollution-related diseases to reduce pollution-levels. Generally, at the road intersections the traffic is heavy, leading to more emissions and creates more air pollution. To reduce traffic congestion, government is taking up several measures such as widening of roads, building of flyovers, laying by bypass roads etc. As several of these works are in progress, traffic can be expected to come down.

Air pollution has the highest effect on health and moderately affects sleep and work. This study also revealed that the introduction of new modes of transport such as MRTS, metro rail and BRTS decrease air pollution significantly. Already, the metro rail project (Phase 1) is in the advanced stage of completion and mono-rail is also planned. Once they are completed, reduction in air pollution levels can be expected. Government should make the bus transport more effective in order to reduce private-car and two-wheeler transport.

3.2 Effects of Air Pollution on Human Health

The problem of health, work and sleep of individuals was also investigated. These issues were considered as a part of the human well-being. The response data (weighted-scores) on these issues are presented in Table 2

Health	Sleep	Work
89	121	123
246	274	254
429	387	336
392	364	452
300	175	190

Table 2.Human well-being (Weightedscore)

3.3 IMPACT OF AIR POLLUTION ON HUMAN HEALTH

The impact of air pollution on human health was assessed based on the responses obtained regarding the various types of symptoms (asthma, cough, sneezing, wheezing etc.) of diseases due to air pollution, experienced by them. Table 4.16 shows the response frequency regarding the symptoms of the diseases caused due to air pollution. From this, it is evident that 78.4 % of the people are affected by pollution-related diseases.

		Frequency	Percent	Valid percent	Cumulative percent
Valid	NO	111	21.6	21.6	21.6
	YES	402	78.4	78.4	100.0
	Total	513	100.0	100.0	

Table 3. Persons having the symptoms of diseases

4. CONCLUSIONS

Due to industrialization and heavy increase in vehicles within the city, enormous undesirable pollutants dominate the atmosphere adversely affecting human health and environment. In this study, the ambient air quality was analyzed in four selected areas of the metropolitan city of Chennai. The daily average concentrations of the major pollutants, sulphur-dioxide (SO_2), nitrogen-oxides (NO_x), suspended particulate matter (SPM), and particulate matter (PM_{10}), for the years 2007 to 2013 should be considered in this analysis. Using IND-AQI procedure, the air quality indices were computed. The air quality index data was analysed using the analysis of variance. It was found that air quality was rated as good in one area and moderate in the other three areas. It was observed that SPM was the major contributor to air pollution. It was also noted that there was considerable increase in the concentration levels of the pollutants over the study period. The study showed that the air quality is better in Chennai city compared to some other metropolitan cities in India.

4.1Chennai ambient air quality for the year 2019

Month& Year	Location	SO_2(µg/m^3)	NO_x(µg/m^3)	RSPM(µg/m^3)
Jan-19	ANNANAGAR	9.5	27.4	97.2
	ADYAR	7.8	14.3	61
	KILPAUK	8.3	23.5	128
	T.NAGAR	8.3	23.9	103
Feb-19	ANNANAGAR	8.8	26.4	119.3
	ADYAR	7.3	11.3	73.6
	KILPAUK	11.2	30.2	110.9
	T.NAGAR	11	35.5	153.4
Mar-19	ANNANAGAR	9.1	30	89.5
	ADYAR	7.1	11.5	43.3
	KILPAUK	10.3	26.3	107
	T.NAGAR	10.4	33.1	116.4
Apr-19	ANNANAGAR	8.7	20.9	117
	ADYAR	7	23.2	36
	KILPAUK	8.1	17.2	95
	T.NAGAR	11.8	22.5	98
May-19	ANNANAGAR	6.1	26.3	79
	ADYAR	6.1	24.2	51
	KILPAUK	8.6	39.8	122
	T.NAGAR	8.1	31.7	147
Jun-19	ANNANAGAR	8.5	25	84
	ADYAR	7.7	13.1	25
	KILPAUK	10.5	33.8	86
	T.NAGAR	12.3	29.7	106
Jul-19	ANNANAGAR	9	19.6	71
	ADYAR	7.3	14	19

Table 4- IMPACT OF AIR POLLUTION

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