ISSN: 2278-4632
Vol-10 Issue-5 No. 15 May 2020

Air Pollution During Pre Pandemic Covid-19 and In The Lockdown Period At Chennai City: A Statistical Study

Dr. R.Arumugam[1], M.Rajathi[2]
[1]Asst. Professor, Department of Mathematics,
[2]Asst. Professor, Department of Education,
[1,2]Periyar Maniammai Institute of Science & Technology, Thanjavur-613403, Tamilnadu, India
Email: arumugamr2@gmail.com, rajathiarumugam@pmu.edu

Abstract

Air quality has been a vital role for the environmental sustainability. In many cities has enhanced air quality over the past few years. Air quality creates an instant threat; particularly an improtant problems like acid rain, global warming and ozone depletion. The air polltion causes various health problem and environmental issues. In this paper, a detailed study on one an important key factor named air quality and air pollution is taken for this study. Also, It has been carried out based on air pollution during pre pandemic and in te lockdown period COVID-19 in Manali area, Chennai city, Tamilnadu State. The significant study of air quality and the comparision of its performance the statistical measures like Analysis of Variance (ANOVA), Descriptive statistics and Cumulative percent were used.

Keywords: Air Quality, ANOVA, Global warming, Descriptive Statistics

1. Introduction

Air pollution and the health of peoples were increased in the last year in significance in society and policy maker has been initiated to build up strategies to reduce health impact of the population [1]. Air quality is connected to increase mortality and morbidity in European countries. Different level of epidemiological studies have showing the relations between an enhance in daily attention of ozone (O_3), particular matter (PM) and Nitrogen dioxide (NO_2). The health problems have been recognized in the multi-centre time series studies [2], [3], [4], [5]. The Health Impact Assesment (HIA) is a method and finding the effect of air quality on the health of human [6], [7]. A statistical study was made for the prediction of Corona virus COVID-19 in India [8]. Also, M.Rajathi, Dr.R.Arumugam were discussed the applications of data mining in the Corona virus pandemic [9]. The impact of Dengue fever in Thanjavur

district based on the statistical study discussed by Dr.R.Arumugam et. al.,[10]. A statistical study was made for the production of Crops befor and after Gaja cyclone in the delta region by Dr.Arumugam.R et.al., [11]. The major frequently used indicator in HIAs has been Nitrogen dioxide (NO_2) and Particulate matter (PM) for the consequence of short-term coverage on mortality [12]. Dry spray deposition model simulated [13] and damp deposition ideas follows [14], [15]. Applications mobile learning through statistical approach in the higher educational institutions was discussed by M.Rajathi and R.Arumugam [16]. Sustainable development is a long term solution for our extreme growthin the future without any distrubments to the environment for the next generations.

2. Methods and Materials

2.1 Data Collection

The data for the Air Quality Index (AQI) was collected from the website https://aqicn.org/city/chennai/ for this study. In this study we are taken a great effort was done to measure the quality from Aug 2019 to May 2020 at the study area of Manali, Chennai, Tamilnadu.

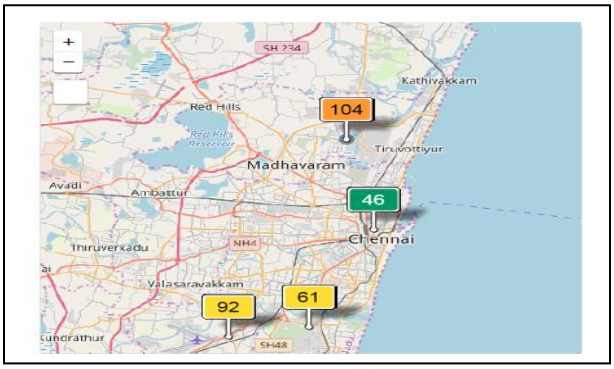


Figure 1: Air pollution location map

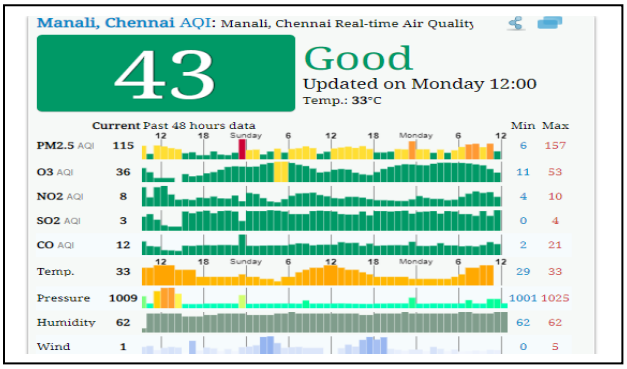
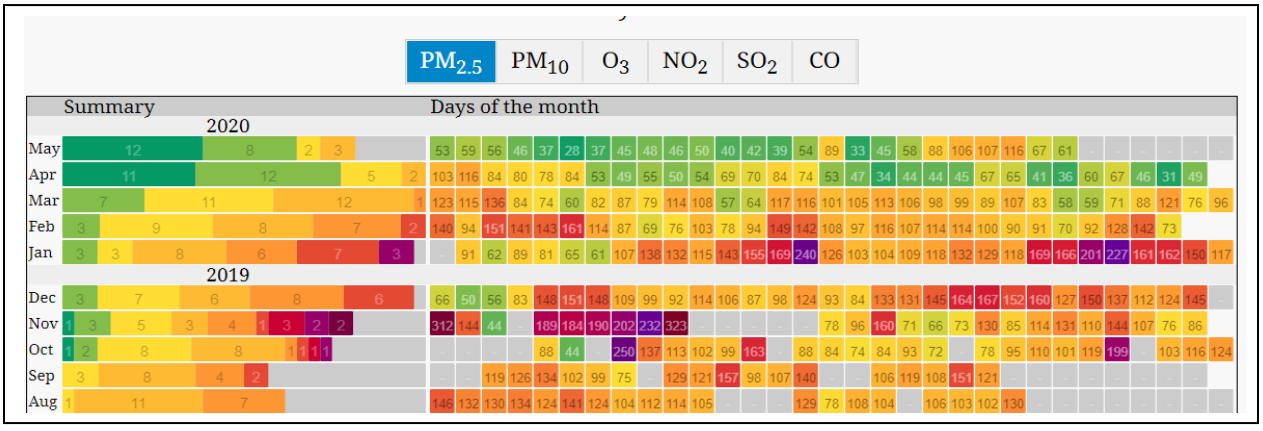


Figure 2: AQI index, Manali, Chennai



ISSN: 2278-4632
Vol-10 Issue-5 No. 15 May 2020

Figure 3: $PM_{2.5}$ AQI data from Aug 2019 to May 2020

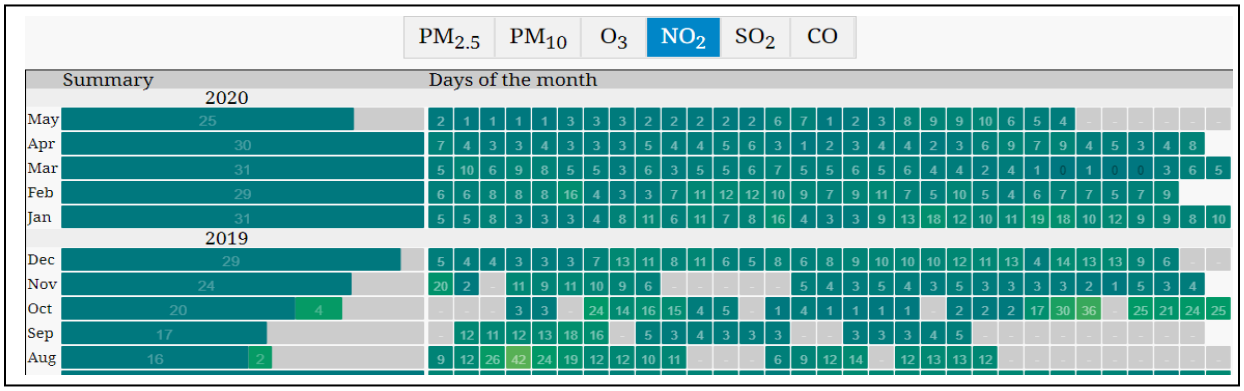


Figure 4: NO_2 AQI data from Aug 2019 to May 2020

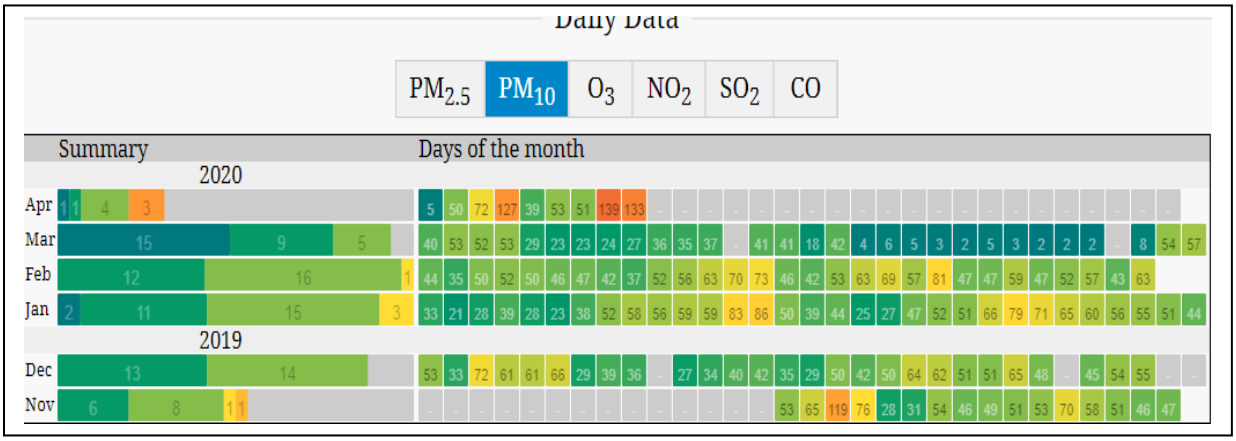


Figure 5: PM_{10} AQI data from Nov 2019 to April 2020

Table 1: $PM_{2.5}$, NO_2, PM_{10}, O_3, SO_2 and CO AQI data from Aug 2019 to May 2020

AQI	sample	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
PM2.5	1	146	-	-	312	66	-	140	123	103	53
	2	132	-	-	144	50	91	94	115	116	59
	3	130	119	-	44	56	62	151	136	84	56
	4	134	126	-	-	83	89	141	84	80	46
	5	124	134	88	189	148	81	143	74	78	37
NO2	1	9	-	-	20	5	5	6	5	7	2
	2	12	12	-	2	4	5	8	10	4	1
	3	26	11	-	-	4	8	8	6	3	1
	4	42	12	3	11	3	3	8	9	3	1
	5	24	13	3	9	3	3	16	8	4	1
SO2	1	2	-	-	3	4	8	7	10	1	1
	2	2	3	-	4	5	4	18	19	2	1

	3	2	3	-	-	3	10	17	29	2	1
	4	3	4	2	6	4	8	18	5	1	1
	5	2	4	3	6	4	5	12	5	2	1
CO	1	9	-	-	13	3	5	10	5	5	8
	2	10	17	-	10	2	7	9	11	4	7
	3	12	18	-	-	5	10	12	5	4	8
	4	11	15	4	8	10	4	11	14	4	7
	5	8	12	2	12	3	6	9	10	5	8
PM10	1	-	-	-	-	53	33	44	40	5	-
	2	-	-	-	-	33	21	35	53	50	-
	3	-	-	-	-	72	28	50	52	72	-
	4	-	-	-	-	61	39	52	53	127	-
	5	-	-	-	-	61	28	50	29	39	-
O3	1	-	-	-	-	29	15	10	25	48	44
	2	-	-	-	-	28	15	10	20	47	46
	3	-	-	-	-	5	15	10	20	52	49
	4	-	-	-	-	9	15	10	17	53	48
	5	-	-	-	-	13	15	10	22	52	53

Ten months data collected from Aug 2019 to May 2020 were collected from the website https://aqicn.org/city/chennai/. Five monitoring stations are there that can communicate the fluctuations of the air quality. In this case study we are focusing the significant changes of air quality based on the statistical tools.

Table 2: Air quality index scale and health implications

API	0-50	51-100	101-150	151-200	201-300	300+
Air pollution Level	Good	Moderate	Unhealthy of sensitive groups	Unhealthy	Very unhealthy	Hazardous
Health Implications	Air quality satisfactory	Air quality acceptable	The general public is not likely to be affected	Serious health effects	Health warning of emergency conditions	More Serious health effects

3. Analysis

Table 3: Descriptive Statistics for Air Quality Index

		Air Quality Index - PM2.5	V2	V3	V4	V5
N	Valid	36	30	20	15	7
	Missing	0	6	16	21	29
Mean			3.000	42.00	33.53	15.00
Std. Error of Mean			.2626	12.298	12.485	12.169
Median			3.000[a]	11.33[a]	12.50[a]	3.00[a]

ISSN: 2278-4632
Vol-10 Issue-5 No. 15 May 2020

Mode			1.0[b]	2	12	3
Std. Deviation			1.4384	54.997	48.356	32.197
Variance			2.069	3024.632	2338.267	1036.667
Skewness			.000	1.164	1.644	2.643
Std. Error of Skewness			.427	.512	.580	.794
Kurtosis			-1.316	-.543	.912	6.990
Std. Error of Kurtosis			.833	.992	1.121	1.587
Range			4.0	144	131	86
Minimum			1.0	2	3	2
Maximum			5.0	146	134	88
Sum			90.0	840	503	105
Percentiles	10		1.000[c]	2.00[c]	3.25[c]	.[c,d]
	25		1.750	5.50	7.50	2.30
	50		3.000	11.33	12.50	3.00
	75		4.250	83.00	17.75	3.88
	80		4.500	127.00	68.50	12.40
	90		5.000	133.00	126.00	71.20

Table 4: Descriptive Statistics for Air Quality Index

		V6	V7	V8	V9	V10	V11	V12	V13
N	Valid	16	30	29	30	30	30	25	0
	Missing	20	6	7	6	6	6	11	36
Mean		49.56	27.63	22.00	37.30	33.80	35.23	21.60	
Std. Error of Mean		22.137	6.307	4.830	8.532	6.797	7.165	4.675	
Median		10.50[a]	8.20[a]	10.71[a]	12.00[a]	19.33[a]	6.50[a]	7.60[a]	
Mode		6	3[b]	15	10	5	4	1	
Std. Deviation		88.549	34.544	26.010	46.733	37.229	39.244	23.377	
Variance		7840.929	1193.275	676.500	2183.941	1386.028	1540.116	546.500	
Skewness		2.280	1.760	1.830	1.685	1.629	.887	.489	
Std. Error of Skewness		.564	.427	.434	.427	.427	.427	.464	
Kurtosis		4.779	3.642	2.325	1.464	1.779	-.365	-1.743	
Std. Error of Kurtosis		1.091	.833	.845	.833	.833	.833	.902	
Range		310	146	88	145	131	126	58	
Minimum		2	2	3	6	5	1	1	
Maximum		312	148	91	151	136	127	59	
Sum		793	829	638	1119	1014	1057	540	
Percentiles	10	3.10[c]	2.83[c]	3.95[c]	7.75[c]	5.17[c]	1.80[c]	.[c,d]	
	25	6.00	3.80	5.50	9.38	9.00	3.43	1.35	
	50	10.50	8.20	10.71	12.00	19.33	6.50	7.60	
	75	32.00	53.00	26.83	48.00	52.00	53.00	47.00	
	80	74.00	57.67	32.00	51.33	53.00	75.00	48.50	
	90	184.50	69.00	73.40	140.50	99.50	93.50	54.00	

Table 5: Cumulative percent of Air Quality Index

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		25	69.4	69.4	69.4
	Air Quality Index - CO	1	2.8	2.8	72.2
	Air Quality Index - NO2	1	2.8	2.8	75.0
	Air Quality Index - O3	1	2.8	2.8	77.8
	Air Quality Index - PM10	1	2.8	2.8	80.6

	Air Quality Index - SO2	1	2.8	2.8	83.3
	CO	1	2.8	2.8	86.1
	NO2	1	2.8	2.8	88.9
	O3	1	2.8	2.8	91.7
	PM10	1	2.8	2.8	94.4
	PM2.5	1	2.8	2.8	97.2
	SO2	1	2.8	2.8	100.0
	Total	36	100.0	100.0	

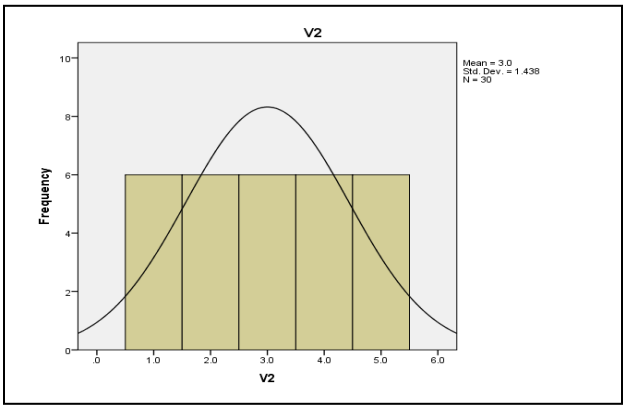


Figure 6: Air Quality Index -August 2019

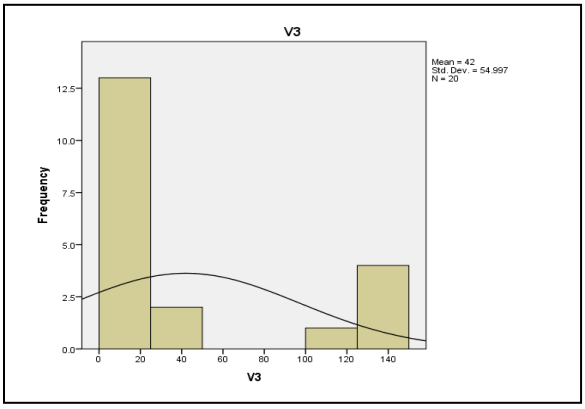


Figure 7: Air Quality Index–Sep 2019

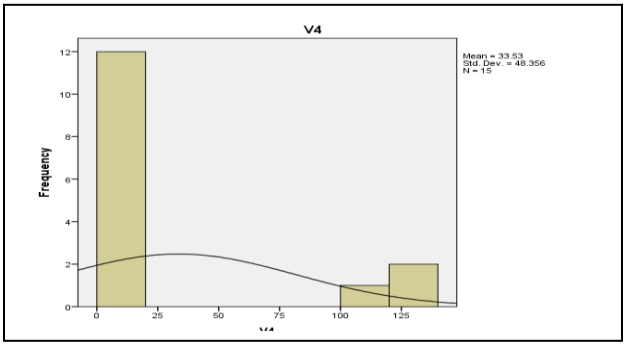


Figure 8: Air Quality Index-October 2019

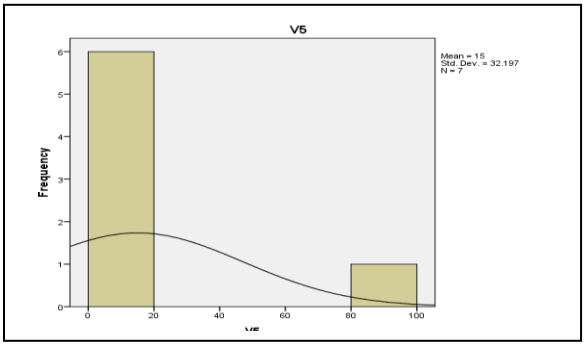


Figure 9: Air Quality Index –Nov 2019

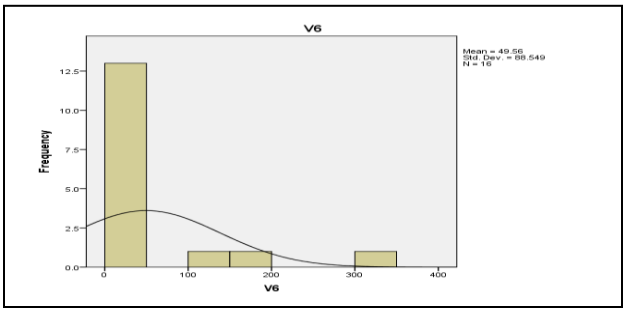


Figure 10: Air Quality Index –Dec 2019

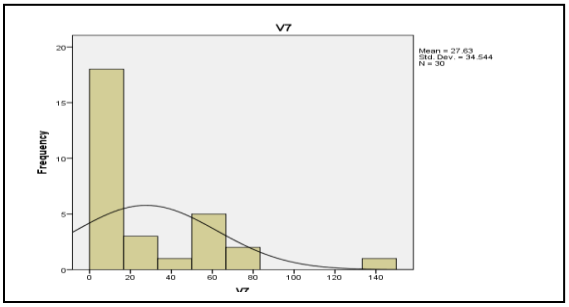
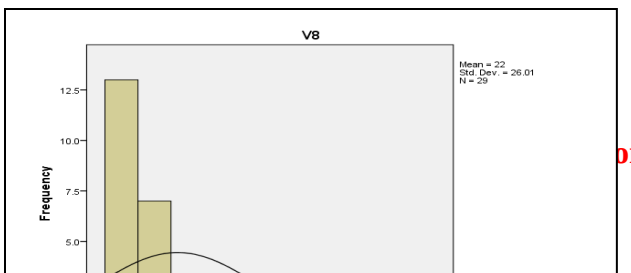
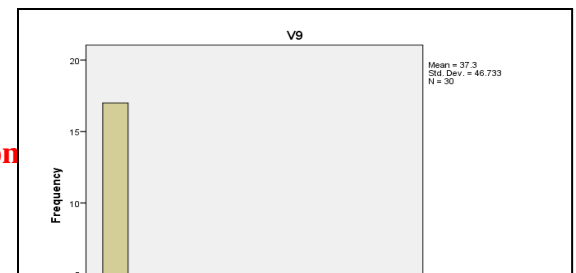


Figure 11: Air Quality Index –Jan 2020

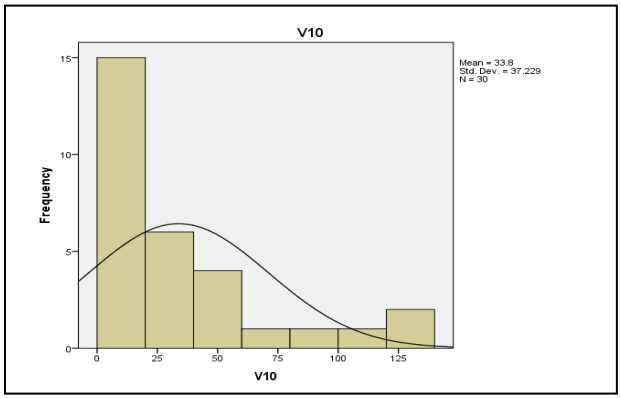




ISSN: 2278-4632
Vol-10 Issue-5 No. 15 May 2020

Figure 12: Air Quality Index –Feb 2020

Figure 13: Air Quality Index –March 2020



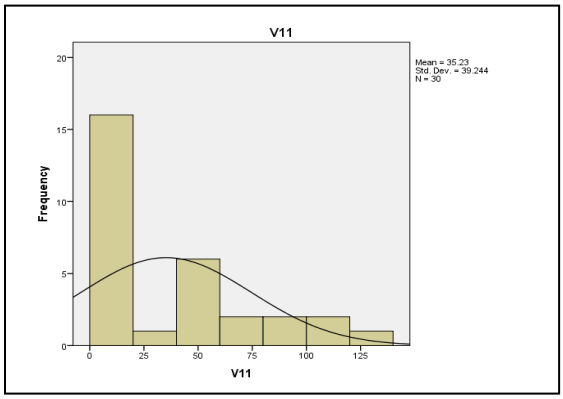


Figure 14: Air Quality Index –April 2020

Figure 15: Air Quality Index –May 2020

Table 6: ANOVA Table for AQI Index

				Sum of Squares	df	Mean Square	F	Sig.
V3	Between Groups	(Combined)		184.000	4	46.000	.012	1.000
		Linear Term	Contrast	8.100	1	8.100	.002	.964
			Deviation	175.900	3	58.633	.015	.997
	Within Groups			57284.000	15	3818.933		
	Total			57468.000	19			
V4	Between Groups	(Combined)		1978.817	3	659.606	.236	.869
		Linear Term	Deviation	714.008	2	357.004	.128	.881
			Unweighted	1464.011	1	1464.011	.524	.484
			Weighted	1264.809	1	1264.809	.452	.515
	Within Groups			30756.917	11	2796.083		
	Total			32735.733	14			
V5	Between Groups	(Combined)		756.000	1	756.000	.692	.443
		Linear Term	Unweighted	756.000	1	756.000	.692	.443
			Weighted	756.000	1	756.000	.692	.443
	Within Groups			5464.000	5	1092.800		
	Total			6220.000	6			
V6	Between Groups	(Combined)		11181.271	4	2795.318	.289	.879
		Linear	Deviation	8045.308	3	2681.769	.277	.841

		Term	Unweighted	3692.430	1	3692.430	.382	.549
			Weighted	3135.963	1	3135.963	.324	.581
	Within Groups			106432.667	11	9675.697		
	Total			117613.938	15			
V7	Between Groups	(Combined)		1130.800	4	282.700	.211	.930
		Linear Term	Contrast	614.400	1	614.400	.459	.504
			Deviation	516.400	3	172.133	.129	.942
	Within Groups			33474.167	25	1338.967		
	Total			34604.967	29			
V8	Between Groups	(Combined)		526.200	4	131.550	.171	.951
		Linear Term	Deviation	289.456	3	96.485	.126	.944
			Unweighted	271.339	1	271.339	.354	.558
			Weighted	236.744	1	236.744	.309	.584
	Within Groups			18415.800	24	767.325		
	Total			18942.000	28			
V9	Between Groups	(Combined)		606.133	4	151.533	.060	.993
		Linear Term	Contrast	209.067	1	209.067	.083	.775
			Deviation	397.067	3	132.356	.053	.984
	Within Groups			62728.167	25	2509.127		
	Total			63334.300	29			
V10	Between Groups	(Combined)		1023.467	4	255.867	.163	.955
		Linear Term	Contrast	459.267	1	459.267	.293	.593
			Deviation	564.200	3	188.067	.120	.947
	Within Groups			39171.333	25	1566.853		
	Total			40194.800	29			
V11	Between Groups	(Combined)		1025.533	4	256.383	.147	.963
		Linear Term	Contrast	74.817	1	74.817	.043	.838
			Deviation	950.717	3	316.906	.182	.908
	Within Groups			43637.833	25	1745.513		
	Total			44663.367	29			
V12	Between Groups	(Combined)		34.800	4	8.700	.013	1.000
		Linear Term	Contrast	14.580	1	14.580	.022	.883
			Deviation	20.220	3	6.740	.010	.999
	Within Groups			13081.200	20	654.060		
	Total			13116.000	24			

4. Discussion and Result

The first figure represent that the Air qulity locations map in Manali area, Chennai. Second figure illustrate the Air Quality Index as on 25th May 2020. Figurer three revealed that the $PM_{2.5}$ AQI data from August 2019 to May 2020. Likewise, fourth and fifth figure point out NO_2 and PM_{10} air quality index from August 2019 to May 2020 and November 2019 and April 2020 rexpectively. The first table indicates the AQI index of $PM_{2.5}$, PM_{10}, O_3, NO_2, SO_2 and CO from August 2019 to 24th May 2020. Second table have been focussing the scale value for the air quality and health implications.

ISSN: 2278-4632
Vol-10 Issue-5 No. 15 May 2020

Third and fourth table explaining the highlighting points of the descriptive statistics, Median is calculated from the grouped data and multiple modes exist in this air quality index. Here, mean and median is greater than the mode; therefore the skewness is positive in all the months.In some cases the kurtosis is less than 3 and many cases greater than 3. Kurtosis were represented that it is lessthan 3 means platic kurtic and greaterthan 3 means leptokurtic.

Fifth table had been representing the cumulative percent of air quality value of CO, NO2, O3, PM10, PM2.5 and SO2. Figure six, seven, eight, nine, ten, eleven, twelve, thirteen, fourteen and fifteen shows that the significant changes based on the AQI index, it is highlighing before lockdown, especially November 2019 the air quality of PM2.5 in the hazardous, it will be more serious health effect compared to the other month's air quality.Sixth table representing the significant level using ANOVA test, in all the level (Months) it is significant at 5% level.

5. Conclusion

From this case study, PM2.5 and PM10 concentrations minimized comparing the pre lockdown of the study period. CO and NO2 have additionally shown massive decline during the lockdown period. Industrial and transportaion sector air quality have been stepped forward compared to the pre lockdown period. Many developing countries have been trying to follow sustainable development to achieve the goal. During the COVID-19 pandemic period had been very much less air pollution is benefiting our health. This will improve our health and it is good for our nation.

References

[1] Künzli N, Kaiser R, Medina S, (2000) Public-fitness effect of outdoor and traffic-related air pollution: a European assessment, Lancet, vol. 356 9232, (pp. 795-801).

[2] Anderson HR, Atkinson R, Peacock JL, Marston L, Konstantinou K, (2004), Meta-analysis of time series research of particulate matter (PM) and ozone (O3). EUR/04/5042688. Copenhagen: WHO Regional Office for Europe; pp. 1-80.

[3] Atkinson R, Anderson HR, Medina S, Iniguez C, Forsberg B, Segerstedt B, et al. (2005), Analysis of all-age respiratory clinic admissions and particulate air pollutants inside the APHEIS programme. APHEIS health impimpact assessment of air pollution and communication strategy. Third 12 months report.

[4] Garrett P, Casimiro E. (2011), Short-term impact of first-class particulate matter (PM(2.5)) and ozone on daily mortality in Lisbon, Portugal. Environ Sci Pollut Res Int

[5] Ruckerl R, Schneider A, Breitner S, Cyrys J, Peters A, (2011), Health consequences of particulate air pollutants: A assessment of epidemiological evidence. Inhal Toxicol; 23: pp. 555-92.

[6] U.S. EPA (U.S. Environmental Protection Agency), (2010): BenMap: Environmental Benefits Mapping and Analysis Program User's Manual, Appendix, Research Triangle Park, NC:U.S. EPA, Office of Air Quality Planning and Standards.

[7] PE Sheffield, K. Knowlton, JL. Carr , PL. Kinne, " Modeling of regional weather change results on ground-level ozone and childhood asthma," Am J Prev Med. 2011;41(3):251–257.

[8] Dr. R.Arumugam, M.Rajathi (2020), A markov version for Prediction of Corona virus COVID-19 in India – A statistical have a look at, Journal of Xidian university, Vol. 14, Issue. 4, pp. 1422-1426.

[9] M.Rajathi, Dr.R.Arumugam (2020), An software of Spatial facts mining within the observe of Corona virus (COVID -19 Pandemic through statistical approach, Aegaeum Journal, Vol. 8, Issue. 4, pp- 1698-1704.

[10] Dr.R.Arumugam, C.Gowri, M.Rajathi (2019), A statistical look at on the Impact of Dengue fever in Thanjavur District the usage of SPSS, Compliance Engineering, Vol. 10, Issue. 12, pp. 671-683.

[11] Dr.R.Arumugam, B.Sri Ranjani, M.Rajathi (2019), A statistical observe at the Production of Crops earlier than and after Gaja cyclone inside the delta place around Thanjavur District, Compliance Engineering, Vol. 10, Issue. 12, pp. 598-607.

[12] WHO. Review of evidence on health components of air pollutants, (2013) – REVIHAAP project: final technical report. WHO, Bonn.

[13] Binkowski, F. S. And Shankar, U. (1995): The Regional Particulate Matter Model: 1. Model description and initial results, J. Geophys. Res.-Atmos., 100, 26191– 26209, doi:10.1029/95JD02093.

[14] Easter, R. C., Ghan, S. J., Zhang, Y., Saylor, R. D., Chapman, E. G., Laulainen, N. S., AbdulRazzak, H., Leung, L. R., Bian, X., and Zaveri, R. A.: (2004), MIRAGE: Model description and evaluation of aerosols and hint gases, J. Geophys. Res.-Atmos., 109, D20210, doi:10.1029/2004JD004571.

ISSN: 2278-4632
Vol-10 Issue-5 No. 15 May 2020

[15] Chapman, E. G., Gustafson Jr., W. I., Easter, R. C., Barnard, J. C., Ghan, S. J., Pekour, M. S., and Fast, J. D. (2009): Coupling aerosolcloud- radiative processes inside the WRF- Chem version: Investigating the radiative impact of elevated point sources, Atmos. Chem. Phys., 9, 945–964.

[16] M.Rajathi, R.Arumugam (2019), Applications of Mobile learning in the higher educational institutions through Statistical approach, International Journal of Recent Technology and Enineering (IJRTE), Vol. 8, Issue. 1, pp-1431-1439.

