Assessing Resident Happiness Amidst Escalating Air Pollution Through Perceptual Survey: A Case Study In New Delhi, India

Section A-Research Paper

ASSESSING RESIDENT HAPPINESS AMIDST ESCALATING AIR POLLUTION THROUGH PERCEPTUAL SURVEY: A CASE STUDY IN NEW DELHI, INDIA

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Abstract

This research paper investigates the impact of air pollution and happiness among residents in Delhi, India. Delhi is one of the most polluted cities in the world, and its citizens face severe health hazards due to air pollution. While previous studies have focused on the adverse health effects of air pollution, the present study investigates its impact on subjective well-being, i.e., happiness. Using data from a survey conducted among a sample of Delhi residents, this study examines the relationship between various indicators of air pollution and self-reported levels of happiness. The results suggest a significant negative relationship between air pollution and happiness, with higher levels of pollution associated with lower levels of happiness. The study also identifies some of the key factors that moderate this relationship, such as socio-demographic variables, perception of health risks, and coping strategies. The findings of this study have important implications for policymakers, urban planners, and public health officials, who must consider the impact of air pollution on subjective well-being while formulating policies and interventions to address this critical issue.

Keywords- *Air Pollution, Happiness level, Urban spaces, Socio well-being, Air Quality Index*

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1. Introduction

Air pollution has become one of the major concerns in the world, especially in developing countries like India. Due to its status as the capital of India, Delhi is recognized as one of the world's most contaminated cities. The residents of Delhi are continuously exposed to high levels of air pollution, which has severe effects on their health and well-being. This paper aims to investigate the relationship between air pollution and resident's happiness in Delhi, India.

According to United Nation (2018), approximately 68% of world population will occupy urban areas by 2050. The increasing urban population and stressful lifestyle as well as exposure of high level of pollution poses serious threat on wellbeing of city and town residents physical health and mental health (Zhang, X., Chen, X., & Zhang, 2020). New Delhi is busy metropolitan city and capital of India. Pollution among urban dwellers causes harmful impact on human wellbeing by affecting psychological and serious threat (Abbot, 2012; World Health Organization, 2006; 2018). The toxicokinetic and laboratory studies also revealed that air pollutants such as PM, O3, SO_2 and NO_2 contributed to various respiratory problems like emphysema, bronchitis and asthma (Ling et al, 2012).

The academic community has shown a dual interest in exploring the connection between the environment and happiness. Firstly, there has been a legitimate curiosity regarding how the environment impacts an individual's subjective well-being. Secondly, researchers have attempted to assign a monetary value to environmental factors, which are public goods often lacking market prices, by using indicators of subjective well-being. (Welsch 2007)

1.1 Air Pollution

Air pollution is the presence of harmful substances in air, including gases, particles, and biological molecules, in the air we breathe. These substances can be released from natural sources such as wildfires and volcanic eruptions, or from human activities such as burning fossil fuels, industrial processes, transportation, and agriculture. Urbanization gave us the benefit of shared facilities in an affordable manner within a reachable distance at a cost of certain problems and hardships. Among these problems, air pollution is a primary concern today. Pollution not only affects the health of human being and other species, but it also reduces the happiness among the people around us. Several

ill effects of air pollution are reported in academic literatures. PM2.5 is responsible for annually 5,70,000 premature mortalities in India, while O_3 was responsible for 31,000 premature mortalities(Chen et al., 2021). We discuss about the harmful effects of components if urban air pollution on human health. Ill-health ultimately affects the wellbeing of an individual reducing happiness and contentment. According to Blacksmith Institute World's Worst Polluted Places report (2008), poor urban air quality and indoor air pollution are considered as world's most hazardous pollution factor. Outdoor air pollution is responsible to 2.1 to 4.21 million deaths per year (Silva 2013,2019).Air pollution leads to casualty of around 7 million people per year worldwide and is considered as the world's largest environmental health threat (Reed, 2016). Children aged less than 5 years in developing countries are the most vulnerable population in terms of total death caused by indoor and outdoor air pollution (Pratit et al., 2020). India accounts for the highest death rate due to air pollution (Harris, 2014). Greenpeace estimated in their study that because of pollutants released by high-emission power stations and vehicle exhausts there are 4.5 million annual premature deaths worldwide along with these 65,000 deaths occur per year in the Middle East due to pollution (Jreissati, 2020). Recent studies in USA and in the cities of Delhi, Mumbai and Kolkata shows that the death related to SARS-COV-2 has a direct positive correlation with percentage of $PM_{2.5}$, CO and O_3 (Meo et al., 2013)(Meo et al., 2022).

Some common air pollutants include:

1) **Ozone**: Surface ozone is formed by photo chemical action on NO_x and Volatile Organic Compounds (VOC) by solar radiation. Major anthropogenic sources of these two compounds (NO_x and VOC) in the city of Delhi is transportation sector, industries and power generation. (Sahu et al., 2015). Automobile exhaust emission consists of toluene, sum of xylene and ethyl-benzene isomer (Henze, 2008). VOC play a significant role in formation of PM_1 having adverse health effects(Li et al., 2009)

• **$PM_{2.5}$ and PM_{10}:** Particulate matters ($PM_{2.5}$) – Tiny particles that can be inhaled and cause respiratory problems. Particulate matters smaller than 2.5 mm are considered as most noxious pollutant as they can be inhaled and enters the lung and damages the respiratory tissues. In Urban and indoor air, cigarette smoke and asbestos fibres are categorised among most dangerous particle

because of their carcinogenic effect that leads to cancer (Cunningham et al, 2005). Air pollutants such as $PM_{2.5}$ induces depressive symptoms (Roberts et al., 2019) and decreases emotional wellbeing in human (Zhang et al., 2019). Lancet (2013) estimated that every increase of $PM_{2.5}$ by $5\mu g/m^3$ induces harmful impact on pregnant women by increasing risk of low birth weight at term increases by 18%. American Lung Association (2013) has listed that particulate matter induces harmful impact on people of all age groups such as infants, children and teens, people over 65 years old, people with heart disease or diabetes and people with lung disease (asthma, chronic pulmonary disease, chronic bronchitis and emphysema), people who work and stay active outdoors. WHO recommended annual limit for PM is 5 $\mu g/m^3$ but in a survey of 20 most polluted cities in India 2022, New Delhi ranks fifth with 84.17 $\mu g/m^3$ over 17-times higher than the WHO recommended limit According to study conducted in 2011 in Delhi, major sources of PM_{10} are power sector (10.5 %), industrial (26%), transport (29%) and residential sector (34.5%). For $PM_{2.5}$ the major contributors in order are power (4%), industry (24%), Residential (27%) and transport (45%) (Sahu et al., 2011). We observe that for $PM_{2.5}$ the major contributor is transport and for PM_{10} the residential sector contributes the most. $PM_{2.5}$ and PM_{10} are the main polluters for the city of Delhi.

- **NO_2 and SO_2**: SO is a gas that can cause respiratory problems and contribute to acid rain and nitrogen dioxide contribute to the formation of smog and acid rain. These two gases have a long-term effect on respiratory system and the children are most vulnerable groups(Fabiana Meijon Fadul, 2019) (Pandey et al., 2005) . Major sources are vehicular pollution. As per data from CPCB the concentration of SO_2 in Delhi is less than 10 $\mu g/m^3$ which is within the red line (CPCB, 2020). Traffic related pollution poses serious threat to biodiversity as well as human wellbeing. The negative impact of NO_2 produced by traffic leads to heightening of psychological stress (Davis et al., 2018).

- **Carbon Monoxide:** Enger & Smith (2000) stated that air containing 0.001 % of carbon monoxide for several hours can be fatal as CO poses binding affinity to haemoglobin for a long time even with small amounts and get accumulated thus reduces the oxygen-carrying capacity of haemoglobin. In addition, CO produced by vehicles in heavy traffic can cause headaches, blurred vision and drowsiness.

- **Ammonia (NH_3)**: Studies have shown that Ammonium Chloride is responsible for aerosol liquid water which is the cause of 'haze' like situation in Delhi. (Chen et al., 2022)

- **Lead (Pb):** Lead is primarily derived from various sources such as fumes from Diesel/Petrol, paints, metal mining and smelting, waste incineration, battery recycling, wood and coal burning. However, the availability of lead-free gasoline has now curbed the emission of lead from fuel. The accumulation of lead in the food chain and inhalation of atmospheric dust particles is how it enters the human body (Järup, 2003). In November 2016, New Delhi experienced a severe air pollution episode, with an unprecedented air quality index (AQI) exceeding 500. The entire National Capital Region (NCR) was affected due to stagnant air and biomass burning aerosols in the plains of Punjab and Haryana. Prior to the severe air pollution episode (SAPE), the PM2.5 concentration was 142 $\mu g/m3$, which rose to 563 $\mu g/m3$ during the episode and reduced to 240 $\mu g/m3$ after it.(Kanawade et al., 2020)

- **Carbon dioxide (CO_2)** – A poisonous gas that can be lethal in high concentrations. Due to greenhouse effect, Carbon dioxide is described as major pollutant and is considered as world's worst climate pollutant (Vaidyanathan, 2014). It is the most essential gas and natural component of air which is given off by human respiratory system and is essential for plant life. (EIA, 2019).

The pollutants in the air can have adverse effects on human health, animals, and the environment. For example, exposure to air pollution has been linked to respiratory diseases such as asthma and lung cancer, heart disease, stroke, and other health problems. Additionally, air pollution can harm crops and other vegetation, reduce visibility, and contribute to climate change.

1.2 Happiness
Measures: Taken self-reported subjective happiness as the proxy measure. Happiness is a positive emotional state characterized by feelings of joy, contentment, and satisfaction with one's life. It is a complex and multifaceted concept that can be influenced by a variety of factors, including genetics, life circumstances, and individual choices and behaviours. Happiness is often associated with a sense of well-being and fulfilment and is often seen as a desirable state to strive for. However, the experience of happiness can vary from person to person and can be influenced by factors such as

cultural norms, personal values, and life goals. Happiness is a subjective experience that can be influenced by a variety of environmental conditions in India.

This paper highlights the increasing recognition of the significant impact of air pollution on human well-being. It concentrates on air pollution as a single component of the natural environment and examines how it has evolved over time, along with the quality of air and the effects of pollution, climate change, and other related factors on global and local environmental conditions. The significance of the environment to individuals appears to be a universal phenomenon globally. The Gallup World Poll, an annual survey conducted in over 160 countries, routinely inquiries about people's attitudes towards the environment.

Urban green infrastructure such as gardens, streetscape greenery and parks reduce the air pollution improving human wellbeing, gaining psychological wellness as well as reduces stress and fatigue (Kaplan and Kaplan, 1989; Ulrich et al., 1991) (Krekel, C., Kolbe, J., & Wüstemann, 2016) . Various research have concluded that the people's feeling and evaluation of life depends on various factors within their surroundings which include geography(Brereton, F., Clinch, J.P., Ferreira, 2008), natural capital (Engelbrecht, 2009), meteorological parameters (MacKerron, G., & Mourato, 2013), land cover (Smyth, R., Mishra, V., & Qian, 2008), air pollution (Zhang, X., Zhang, X., & Chen, 2017) (Garrett, 2004), noise pollution (van Praag, B. M. S., & Baarsma, 2005), infrastructure (Krekel, C., Kolbe, J., & Wüstemann, 2016), and natural disasters (Lüchinger, S., & Raschky, 2009).

1.3 Relation of Air pollution and happiness

Researchers have already document that prolong exposure to air pollution increases more perceptible health risks, such as cardiovascular (heart related) diseases (Gallagher et al. 2010), respiratory diseases (lungs related) (Moretti and Neidell 2011; (Beatty and Shimshack 2014), hospitalizations (Neidell 2009; Lleras-Muney 2010), and mortality (Jayachandran 2009; Chen et al. 2013; Greenstone and Hanna 2014; Tanaka 2015). However, much less is known about how air pollution impairs less tangible outcomes like mental health, level of well being and level of happiness, which complement the direct monetary measures of welfare (Graham 2005). The growing literature on economics of happiness has promoted more and more nations to incorporate happiness as an important component in policy making and

measuring economic and social well-being in their framework of 'to do' list (Levinson 2013).

The few existing research on the linkage between air pollution and happiness primarily rely on aggregate pollution and happiness data (Menz 2011) or individual-level repeated cross-sectional data (Levinson 2012). Studies based on aggregated data, however, are subject to the *environmental myth*. That is, the findings may differ or even contradict each other depending on the level of aggregation (Deaton and Lubotsky 2003).

Before working on research that how a healthy and green natural environment affects our happiness, let's ask ourselves why we think nature affects our happiness in the first place. There are three reasons for this. Firstly, it is the biological reason of connectivity; there is the idea of "biophilia," which suggests that humans have an instinctive connection to other living things or specific environments due to biological evolution. As a result, nature can have a direct and positive impact on happiness because of our evolutionary past, because we both have grown together (Wilson 1984) Research in mental psychology indicates that mental well-being can be enhanced by exposure to green and natural surroundings. (Guite et al (2006); O'Campo et al(2009); Annerstedt et al (2012)) It includes less stress, more positive sentiments (Ulrich 1983,1984);Ulrich et al (1991)), cognitive restoration (Berman et al (2008)), and positive effects on self-regulation.(Hartig et al(2003)) Second, green and natural surrounding may have *indirect* positive impacts by inspiring certain behaviours, for example, physical exercise, yoga or social interaction, through the provision of public, open space, which improves mental or physical health and longevity, and thereby happiness. Longevity, Overall happiness and wellness are well connected. There is a lot of studies which talk about health benefits of green environment. (de Vries et al; Mass et al (2006))

There is evidence in the medical and epidemiological literature for both mechanisms: natural and green environments encourage physical activity, which brings about health benefits (that may be unevenly distributed amongst the population while encouraging social interaction. (Leslie & Cerin(2008)) It is also stated that socialising with your relatives and friends gives feeling of happiness . (Kahneman et al,2004) Green and natural surroundings could potentially possess superior environmental quality due to the absence of environmental stressors, such as air and noise

pollution, which are linked to respiratory and cardiovascular ailments as well as increased stress levels. These physiological benefits may instigate the positivity's in an individual. Furthermore, they may offer environmental benefits such as scenic beauty and land coverage for recreational purposes. While both factors indirectly influence happiness, stressors can also have a direct effect by causing concern when they are prominent in people's minds. (Mackerron 2020)

1.4 Case Study Area - Delhi
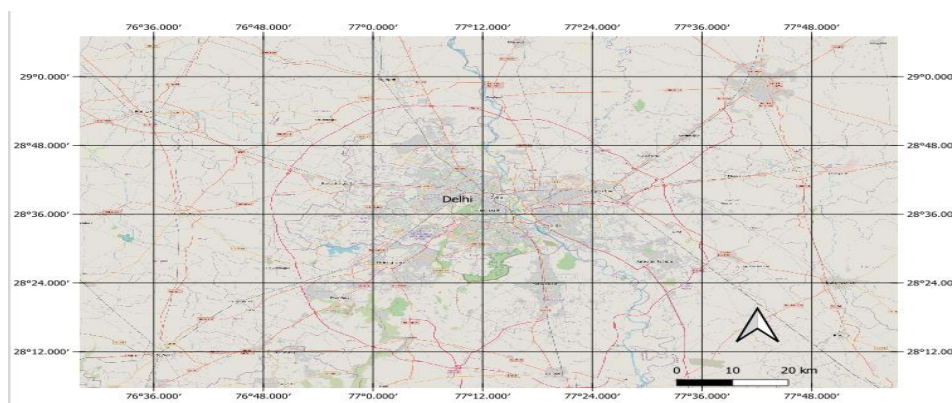
Air pollution is a complex issue that is caused by various factors such as traffic congestion, industrial activities, and the burning of fossil fuels. Delhi, being the capital city of India, is a hub of industrial and commercial activities. Additionally, the high population density and increasing number of vehicles on the roads have contributed to the worsening of the air quality in Delhi. According to the World Health Organization, Delhi has been ranked as the most polluted city in the world in recent years. Air pollution has become a major public health issue in Delhi, leading to various respiratory and cardiovascular diseases.

New Delhi is the capital city of India (28.57°N, 77.11°E, 220 m avg. msl) It's a large urban agglomeration with a population of **16,349,831**(Census of India, 2011)**.** Apart from capital functions**,** the city of Delhi caters to many educational institutions and health centres. Delhi has a registered motor vehicle of 11.39 million up to March 2019. Climate of Delhi falls under 'composite climate'. Temperature and Humidity data of Delhi is tabulated (Table 1). Heat index is the combined effect of ambient temperature and the humidity (R. G. Steadman, 1979). It does not consider the effect of wind velocity and the radiation. In this case heat index is calculated with the help of online calculator using temperature and humidity data. (calculator.net 2023) (Table 2). Figure 1 shows the heat index based on ambient temperature and relative humidity (RH). In extreme weather conditions people are confined to the interiors. Outdoor spaces are used when the ambient temperature is within the adaptive range of comfort. Usage of outdoor spaces in adverse condition gives a feeling of unhappiness.
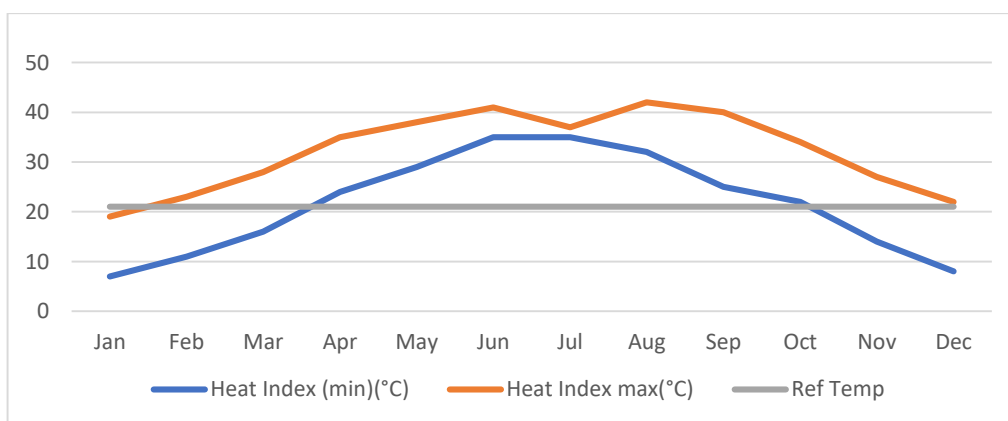

Figure 1 Monthly Heat Index Variation of Delhi
Source: Author

Table 1 temperature and Humidity of Delhi

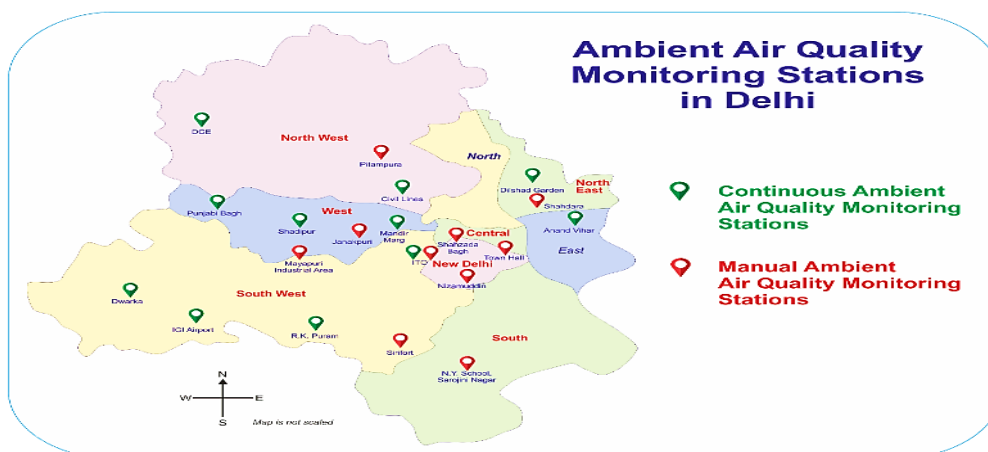| Delhi	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Min (°C)	8	11	16	23	27	28	28	27	25	21	14	9
Max (°C)	20	24	30	37	40	39	35	34	34	33	28	22
Avg. Tem (°C)	13.5	16.9	22.5	29.2	32.7	33	29.9	28.7	27.8	25.4	20.5	15.4
RH Avg. (%)	75.9	66.6	52.5	44.4	41.7	56.6	79.6	81.8	82	70	70.3	76.5
RH min (%)	44.9	37.5	24.2	15.6	14.9	30	40.2	60.3	55.4	39.7	36.3	49.4
RH max (%)	100	94.4	87.5	84.9	74.1	95.1	96.2	95.5	98.2	90.4	93.6	97.2

Source: Author

Figure 2 *AQI Monitoring stations in Delhi.*
Source: CPCB

Table 2. *Daily Average AQI data for approximately 30 monitoring stations of Delhi (2022)*

Delhi (AQI) 2022(Date)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	362	346	170	218	256	322	76	71	121	186	424	368
2	404	319	225	226	218	202	95	84	110	181	376	352
3	387	321	178	245	227	240	76	122	119	128	450	370
4	378	152	199	262	269	227	113	112	115	150	447	407
5	397	224	115	233	146	215	161	72	102	211	381	347
6	258	285	162	248	273	195	104	98	19	79	339	353
7	182	250	237	264	206	280	100	118	133	55	354	304
8	91	270	283	242	205	346	94	84	136	56	372	281
9	69	227	162	261	171	223	110	112	141	48	260	314
10	151	172	150	244	160	303	71	102	110	44	295	360
11	224	184	164	258	156	256	95	75	85	66	346	306
12	191	191	160	229	164	249	87	88	84	143	303	218
13	321	253	193	286	176	200	89	80	72	130	303	177
14	348	239	231	280	270	222	87	84	71	154	294	163
15	258	221	253	201	242	153	79	62	57	186	227	189
16	264	272	218	253	297	132	81	63	47	232	264	223
17	327	241	218	251	239	88	61	60	70	237	260	304
18	352	252	293	257	251	102	92	72	119	241	289	353
19	322	180	231	317	202	99	105	71	182	228	280	410
20	387	173	242	277	266	124	98	80	130	232	314	366
21	365	165	271	296	285	128	70	114	109	262	310	328
22	316	252	180	204	203	139	140	104	66	265	255	342
23	202	211	206	245	136	140	72	83	57	259	237	359
24	241	307	280	261	89	197	72	63	54	312	213	349
25	234	286	211	244	166	230	67	96	52	302	294	308

26	260	102	207	209	199	169	69	113	100	271	336	331
27	262	92	195	287	206	127	74	105	108	354	328	339
28	215	107	251	295	210	137	68	119	140	357	333	321
29	251		274	299	273	163	71	144	151	397	369	306
30	278		276	270	201	116	58	116	173	352	365	399
31	338		298		215		71	124		392		349

Source: CPCB, India

Table 3. *Basic Statistical data for AQI (Delhi 2022)*

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	278.5	224.8	217.2	255.4	212.2	190.8	87.3	93.3	101.1	210.0	320.6	319.2
Std. Error	15.7	12.6	8.5	5.3	8.9	12.5	4.0	4.0	7.2	18.8	11.1	11.5
Median	264.0	233.0	218.0	255.0	206.0	196.0	81.0	88.0	108.5	228.0	312.0	339.0
Mode	387.0	252.0	162.0	245.0	273.0	#N/A	71.0	84.0	110.0	186.0	260.0	353.0
Std. Dev	87.5	66.8	47.6	28.9	49.7	68.7	22.5	22.3	39.2	104.9	60.8	64.1
Sample Var.	7661.9	4464.9	2266.1	837.0	2465.8	4719.3	507.2	496.8	1536.9	11002.8	3700.1	4108.4
Kurtosis	-0.1	-0.4	-0.8	-0.3	-0.2	-0.5	3.1	-0.9	-0.5	-0.9	-0.2	0.7
Skewness	-0.6	-0.3	0.0	0.0	-0.3	0.5	1.5	0.3	0.0	0.0	0.4	-1.1
Range	335.0	254.0	183.0	116.0	208.0	258.0	103.0	84.0	163.0	353.0	237.0	247.0
Minimum	69.0	92.0	115.0	201.0	89.0	88.0	58.0	60.0	19.0	44.0	213.0	163.0
Maximum	404.0	346.0	298.0	317.0	297.0	346.0	161.0	144.0	182.0	397.0	450.0	410.0
Sum	8635.0	6294.0	6733.0	7662.0	6577.0	5724.0	2706.0	2891.0	3033.0	6510.0	9618.0	9896.0
Count	31.0	28.0	31.0	30.0	31.0	30.0	31.0	31.0	30.0	31.0	30.0	31.0

Source: Author

Monthly Mean AQI

$$y = -0.0072x^6 + 0.133x^5 + 0.4962x^4 - 22.773x^3 + 150.67x^2 - 365.06x + 516.33$$
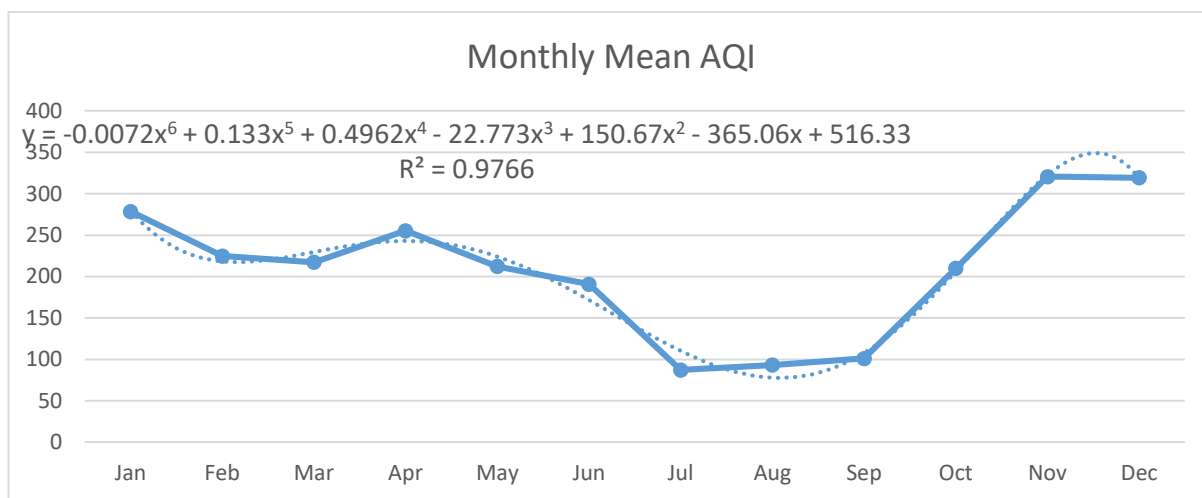$$R^2 = 0.9766$$

Figure 3 *Monthly AQI Analysis*
Source: Author

Reducing air pollution requires a combination of individual and collective actions. Individuals can take steps such as reducing their use of personal vehicles, conserving energy, and using cleaner technologies. Governments and industry can implement policies and technologies to reduce emissions from transportation, power generation, and industrial processes.

2. Methods

This study hypothesizes that presence of high pollution in air is negatively associated with the life satisfaction and happiness of Delhi residents. To test the hypotheses, a survey is conducted on a particular area of Delhi (Okhla, Jamia Nagar) in which almost 500 households stay in a particular society. Many of them participated and showed their concerns towards increasing air pollution. Minimum sample size required for 95 % Confidence Interval with a margin of error 5% and a population proportion of 50% is 218. Residents were asked to fill a questionnaire form regarding air pollution and sense of happiness and contentment. Following factors were taken into considerations.

• Taken a case of Delhi within PIN Code of 110025 (Okhla, Jamia Nagar)
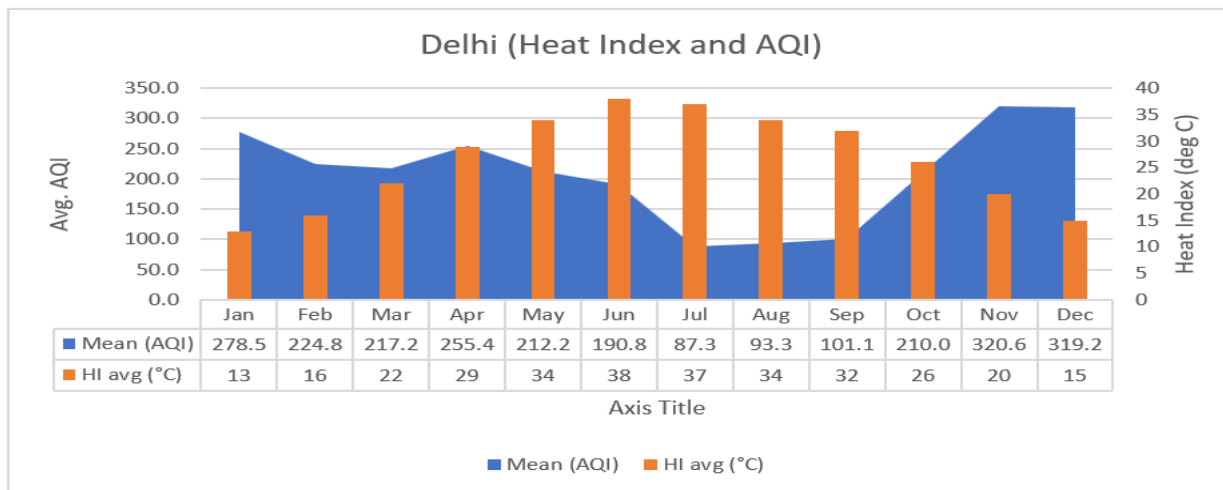• Genuine responses are being recorded.

Table 4. *Sample Statistics*
Source: Author

• Various factors are taken care of, like gender, age, profession, and place of residence.

Factor	Category	Number of Responses
Gender	Male	127
	Female	99
Age	18-25	62
	26-35	68
	36-45	42
	46-55	30
	Fifty-six and above	24
Profession	Student	90
	Service	70
	Business	60
	Other	6
Area of Living	South Delhi	226
Total		226

In this Table-5, the numerous factors are presented in the first column, with each category listed below. The second column shows the specific category within each factor, such as male or female for gender, and the third column displays the number of responses within each category. The final row presents the total number of responses that were recorded. In a population size of five hundred households in a residential colony total 226 samples were collected. Among this 55.8% were male and 44.2% were female respondents. People believe that pollution is rising through various sources like Smart phone AQI data, news agency, visually perceivable or deteriorated health condition. As per the survey report 36.3% got to know the increased pollution level when their health suffered, where 44.2% gets it visually perceived in the form of smoke and smog, 11.5% got to know from news and 8% through social media.
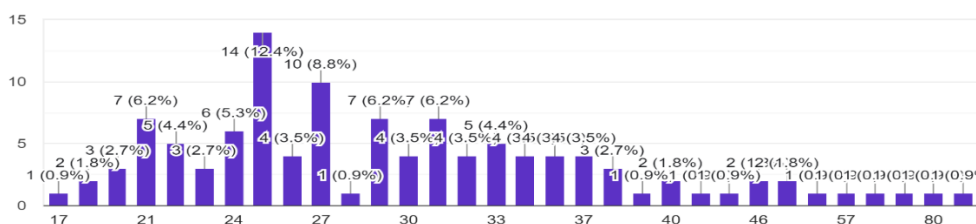

Figure 5 *Age of the respondent*

Source: Author

Figure 5 shows plotted coefficients shows the age of the respondents. Most of the respondents were aged between 20-30 years. Figure 6 shows the scale of happiness. On a scale of 1 to 10, The Question was: How happy are you with your current living situation, in terms of environment?
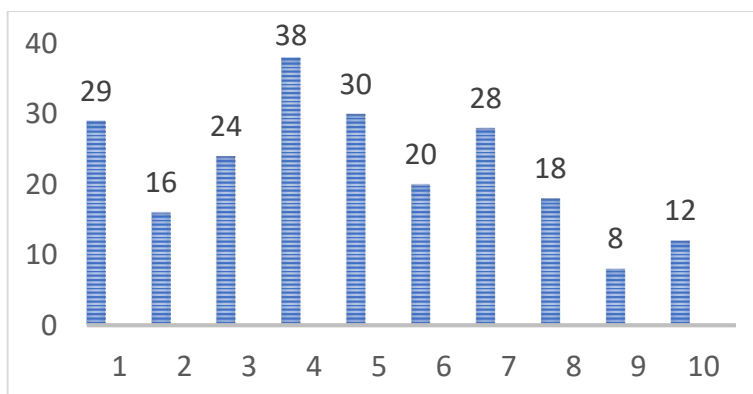

Figure 6 *No of respondent and the Scale of Happiness (1 being very Unhappy and 10 being Very Happy)*
Total Sample size 226
Source: Author

Out of 226 responses 92.9% believes that air pollution affects their overall wellbeing. Based on the survey results, a significant percentage of people in the surveyed area are experiencing health issues related to air pollution. Out of the 226 responses, 65.5% reported experiencing such issues, while 23% did not and 11.5% were unsure. When asked whether they avoid going outside when air pollution is high, 67% of respondents said that they do, while 13.4% said they do not and 19.6% were unsure. Additionally, the survey found that 88.5% of residents do not allow their family members, including children and senior citizens, to go outside when pollution level is high. Only 8% of residents allow their family members to go outside that too sometimes. Regarding indoor air quality, 50% of respondents reported feeling a sense of suffocation when inside their homes. However, despite this, only 35.4% of Delhi residents use air purifiers to improve indoor air quality. How concerned are you about air pollution in your area?
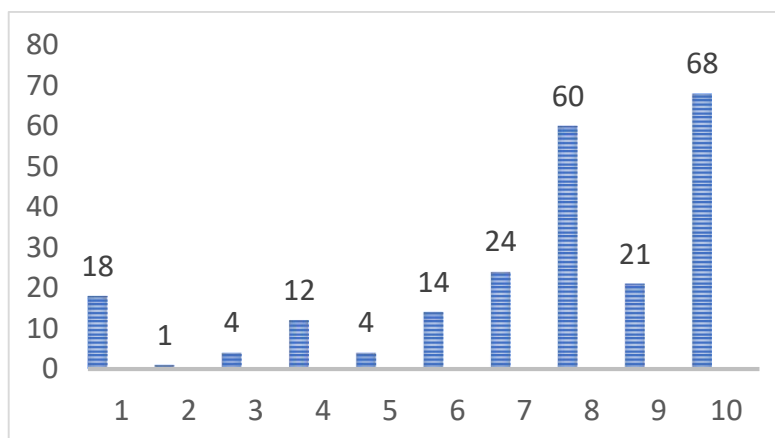

Figure 7 *No of respondent who are concerned about Air Pollution (1 being least concerned and 10 being Very*

Concerned) Total Sample size 226
Source: Author

From fig 7, it can be clearly seen that residents are quite concerned for the rising air pollution in their area.33.6% respondents are fully concerned for the issue. On a positive note, 90.3% of people are taking steps to reduce their exposure to air pollution, such as wearing masks, reducing time spent outdoors, and using air purifiers. However, when asked about the actions being taken by the local government, 70.8% of respondents said that the government is not taking enough actions to address the issue, while 21.2% were unsure about government.
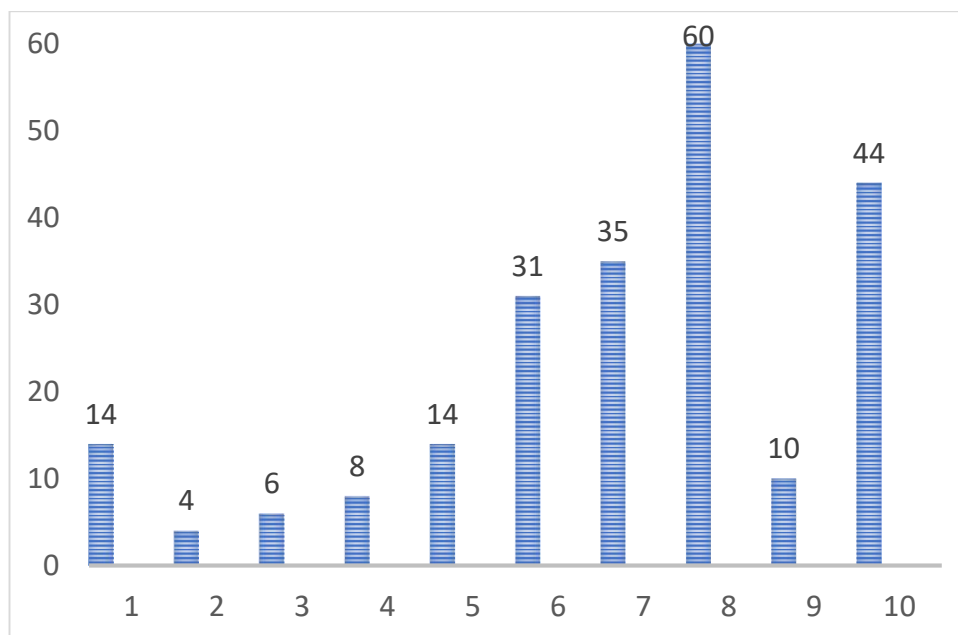
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Figure 8 *No of respondent showing overall happiness level on scale of 10 (I being least happy and 10 being very happy)*
Total Sample size 226
Source: Author

When asked about their overall impact on happiness, they highlight affecting numbers as shown in fig 8. Almost 30% of respondents says that air pollution impacts their happiness majorly. The survey also discovered that when people are unable to walk outside, they engage in yoga, grow plants inside their homes, or travel to a location with superior air quality for a holiday. Due to health and environmental problems, Delhi is not many respondents' first choice of place to live.

3. Results and Discussion
The study findings suggest that air pollution has a detrimental effect on the well-being of Delhi's inhabitants. The regression analysis revealed that air pollution is a noteworthy determinant of happiness. Additionally, the research showed that air pollution has an unfavourable impact on health, which ultimately diminishes the level of happiness. The study investigated the impact of air pollution on the happiness of residents in Delhi, and the findings revealed that air pollution has a negative effect on happiness. The research employed regression analysis, which is a statistical technique that measures the strength of the relationship between two or more variables. The results indicated that air pollution is a significant predictor of happiness, meaning that an increase in air pollution levels leads to a decrease in happiness levels of Delhi's residents.

Furthermore, the study found that air pollution also has adverse effects on health, which in turn negatively impacts happiness levels. These

findings are consistent with previous research that has linked air pollution to a wide range of health problems, including respiratory diseases and cardiovascular diseases. The survey report highlighted that the people of Delhi are seeking alternate options during high pollution months. This indicates that air pollution is a major concern for residents in Delhi and that they are looking for ways to mitigate its impact on their lives. Overall, this study provides further evidence of the negative impact of air pollution on the well-being of individuals and highlights the urgent need for measures to reduce air pollution levels in Delhi.

Upon interaction with household dwellers in Zakir Road, Okhla, New Delhi, people had horrible experience of pollution. They keep the windows shut and balcony is unused because of dust. Roads are metalled but the footpath and the spaces between footpath and road is left uncovered. Dust moves from that area when vehicle passes through it. Suspended Particulate Matter (SPM) which is commonly known as dust in common parlance is the major pollution in the houses. Paradoxically the residents don't consider dust as a pollutant but it's a menace. Upon interaction the pollution means smoke and smog which is visible in Winter. Upon interaction people revealed that they have to do dusting of exposed item on daily basis. Open cupboards are most problematic when a thick layer of dust keep on resting if not cleaned regularly. People also complain that their ceiling fan and pedestal fan blades get dusty and thick dirt get deposit on edge of fan blade. They must clear their

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Section A-Research Paper

AC filters on monthly basis. Even the cooling coils needs cleaning else the cooling through AC is severely hampered. The plantation in their balconies needs constant sprinkling to remove the dust. Even the window grills get dusty and must be cleaned on daily basis. Upon interaction the ladies of the house revealed that they use wet clothes to remove dust.

4. Conclusion

According to the research, air pollution has a considerable and unfavourable effect on the happiness of people living in Delhi, India. The study emphasizes the need for the government to take necessary steps to address the problem of air pollution in Delhi to enhance the quality of life and happiness of its inhabitants. The researchers propose that measures such as removing dust from road using vacuum suction machine at frequent intervals, water spraying on roads, reducing vehicular emissions, controlling industrial pollution, and promoting the use of renewable energy sources should be implemented to mitigate air pollution.

Additionally, the study points out that there could be other environmental factors that influence the well-being and happiness of Delhi residents, which require further investigation. The research recommends conducting more studies to explore these other factors and understand their impact on the happiness of people living in Delhi. In conclusion, the study highlights the significance of addressing air pollution as a crucial step towards promoting the well-being and happiness of the residents of Delhi, India.

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