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A SURVEY ON THE CORRELATION BETWEEN PM2.5 CONCENTRATION AND THE POSITIVE CASES OF COVID-19 DISEASE TO MEDICAL CENTERS: A CASE STUDY OF GURUGRAM

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Abstract: One of the biggest health problems of the twenty-first century, COVID-19 has killed over 6 million people globally and infected millions of more. The novel SARS-CoV-2 virus is the cause of this illness; it is still spreading over the world, occasionally taking on new and more complicated features. This observational study aims to explore the role of PM2.5 and the correlation it has with the incidence of COVID-19 suspected cases (SC) and positive cases (PC) at varying levels of the air quality index (AQI) in Gurugram, Iran's capital, between 2020, and 2021. Under the direction of Gurugram Municipality, data on the AQI were gathered online from the Air Quality Control Company's air monitoring website. The Iranian Ministry of Health provided the information on positive and suspected cases. The findings and statistical analysis (Pearson correlation test) demonstrated that the number of suspicious cases (SC) and positive cases (PC) rose along with the AQI level (P-value).

Keywords:COVID-19, positive cases, statistical analysis

1. Introduction:

In order to determine the relationship between daily COVID-19 instances and PM2.5 concentrations for the research area, we used the Pearson correlation approach. Additionally, we separated the number of COVID-19 cases into the pre-monsoon (MAM), monsoon (JJA), post-monsoon (SON), and winter (DJF) seasons to gain a better picture of seasonal fluctuation and their correlation with PM2.5. We gathered data on COVID-19 instances from March 2020 to February 2022 as COVID-19 first appeared in Gurugram in March 2020. The significance levels of 0.01 and 0.05 were used to examine correlations.

The monsoon season of June through August (JJA) of the year 2020 for Gurugram showed a negative association (r= -0.536) between the number of COVID-19 cases and PM2.5, which may have been caused by the precipitation-induced drop in PM2.5 levels and subsequent clearance of the pollutants. On the other hand, during the winter of December–February (DJF) in the year 2020, there was a strong positive correlation between PM2.5 and COVID-19 instances (r= 0.233). In the northern portions of the state during the winter, there is a lot of biomass burning, which raises pollution levels in the nearby areas. This may be the main contributor to the observed positive correlation between COVID-19 instances and (PM2.5). However, Zoran (2020) found that the COVID-19 cases outbreak in Milan was strongly influenced by daily averaged particulate matter concentrations, positive associations with average surface air temperature, and inverse relationships with air relative humidity. Since COVID-19 is a new pandemic coronavirus (SARS-CoV-2 variant), it may be active in the summer when temperatures are higher and humidity levels are lower (Zoran et al., 2020). We observed a seasonal shift in relation in the second wave of the COVID-19 pandemic during the pre-monsoon (MAM) season in 2021 as compared to the previous year. Pre-monsoon season has a significant negative association (r= -0.558) but post-monsoon season has a substantial positive correlation (r=0.716) between COVID-19 instances and PM2.5 concentrations. Surprisingly, the winter season of 2021 had a significant negative correlation (r= -0.558). In this season, a lower-case count was connected to an early lockdown (Figure 4.2).Recent evidence supports our findings, such as the fact that daily COVID-19 infection cases were strongly negatively correlated with the minimum temperature in Ahmedabad (r = 0.38) and significantly positively correlated (r=0.46) with absolute humidity in Delhi, Mumbai, and Pune. As a result, the rate at which COVID-19 spread around the city increased because to the lower temperature and high humidity. According to Wang et al. (2020), the particulate matter pollution is positively connected with an increase in COVID-19 cases and higher mortality rates. Additionally, our research shows that COVID-19 instances in Gurugram are strongly related to PM2.5 levels. Cole et al. also noted that a 1 g/m3 increase in PM2.5 concentrations resulted in 9.4 times as many COVID-19 cases and 2.3 times as many fatalities (Cole at al., 2020). Chinese residents who resided in areas with high levels of air pollution were more likely to die from SARS than those who did not (Liu et al., 2020; Li et al., 2020; Manne et al., 2020; Ortiz et al., 2020). Researchers have determined that a number of viruses, such as the adenovirus and influenza virus, can be carried on airborne particles. Zhao et al. came to the conclusion that particulate matter was a factor in the 2015 avian influenza outbreak (Zhao et al., 2020). According to Chen et al. and Cao et al. (2020), particle pollution can hasten the progression of respiratory illnesses and increase the risk of mortality. Air pollution with higher PM concentrations may encourage the propagation of the SARS-CoV-2 virus. Therefore, it is critical and important to clarify the function of airborne particle contamination in the propagation of viruses (Barakat et al., 2020).

2. Objective

- To Study The Correlation Between Pm2.5 Concentration And The Positive Cases Of Covid-19 Disease To Medical Centers: A Case Study Of Gurugram

3. Materials and method

3.1 Study area

Based on information gathered from the Gurugram Air Quality Control Company, PM2.5 has been identified as an indicator pollutant nearly all year long. As a result, the AQI in relation to PM2.5 has been examined in this study. The current investigation was carried out in the Iranian province of Gurugram as an observational research. According to Delavar et al. (2019), this city is regarded as one of the most polluted in the world in terms of particle matter (PM2.5) emissions. Gurugram has a population of more than 13 million people with more than four million vehicles, three million motorcycles, and has numerous industrial and commercial centres which are located between latitude 35◦ 41′ 39.80′′ N and longitude 51◦ 25′ 17.44′′ E (Vakili et al., 2015).

3.2 Data collection

Under the direction of Gurugram Municipality, data pertaining to the air quality index (AQI)

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were gathered every day for a year (from February 20, 2020, to February 22, 2021) via the Air Quality Control Company's online monitoring site. Only twenty of the thirty-two air pollution monitoring sites in Gurugram City had data available. The AQI is categorised into six levels based on how different contaminants affect human health. Level I is green (good), Level II is yellow (acceptable), Level III is orange (unhealthy for sensitive groups), Level IV is red (unhealthy), Level V is purple (very unhealthy), Level VI is brown (hazardous), and Level III is green (good) to 50. Data on suspected and positive cases of COVID-19 disease were obtained from the Ministry of Health and Medical Education of Iran on April 20, 2021.

3.3 Statistical approach

The gathered data were examined using the IBM Corp., Armonk, NY, USA, SPSS 26.0 package software. Initially, the Kolmogorov-Smirnov test was used to determine if the data were normal. The test findings demonstrated the normal distribution of the data acquired in this. The association between the AQI, PM2.5, and the characteristics of suspected and positive cases was examined using the Pearson correlation test. The impact of different seasons on the quantity of suspected and confirmed patients sent to medical facilities has been compared using the generalised estimating equations (GEE) method. In this model, winter was considered as a reference season due to less fluctuation (in terms of the number of suspected and positive cases) than other seasons. All statistical data were analyzed at a p-value of 0.05.

4. Results

The Pearson connections between COVID-19 cases, PM2.5 concentrations, and meteorological indicators have been identified; however, a thorough and critical examination is needed to comprehend seasonal variations from year to year and responsible features. In order to visualize the patterns and correlations between the daily COVID-19 instances, pollutant (PM2.5) concentrations, and meteorological factors (temperature, RH, and wind speed), we utilized principal component analysis (PCA). After measuring the data sets on various scales and standardizing the variables, PCA was applied to the correlation matrix (Wilks 2011). All principle components' (PCs) Eigenvalues were calculated for both years.

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Eigenvalues help determine how many PCs are needed for interpretation. According to Kaiser's Rule, PCs with eigenvalues less than 1 cannot be evaluated since they contain irrelevant data (Wilks 2011). Only two of the five PCs that had eigenvalues greater than 1 were chosen for further processing. Table 1 lists the Eigenvalues and total variance of a few PCs for the years 2020 and 2021. Additionally, the PCs created a factor loadings matrix for interpretation and were vulnerable to varimax rotation.The significance between the components is evenly distributed thanks to the PCs' rotation (Figure 1).

TABLE 1:EIGENVALUE AND VARIABILITY OF PRINCIPAL COMPONENTS (PC) REFLECTING PM2.5CONCENTRATIONS,METEOROLOGICALPARAMETERS,ANDDAILYCASE SOFCOVID-19INFECTION

Year		**2020**			**2021**	
	PC1		PC2	PC1		PC2
Eigenvalue	2.5892		1.0809	2.0774		1.3515
Variability(%)	51.784		21.619	41.547		27.03
Cumulative variability %	51.784		73.403	41.547		68.577

We have shown the relationships between the daily COVID-19 instances, PM2.5 concentrations, and meteorological factors such as temperature, relative humidity, and wind speed. The summary plots for 2020 and 2021 that depict the total variation of the PCs as a result of the loading variables. Eigenvalue (2.59), PC1 with 51.78% variance, and daily COVID-19 instances all show substantial positive factor loadings in 2020. However, PC1 for the year 2021 with a 2.08 eigenvalue and 41.5% variance indicates blatantly positive factor loadings for PM2.5, RH, and daily cases of COVID-19 but just marginally positive factor loadings for wind speed. In the months of November and December of the year 2020, a substantial association was seen between the relative humidity, the temperature, and the number of daily instances of COVID-19. The strongly associated variables are shown in Figure 1, A and B. According to one interpretation, the daily COVID-19 instances had a weak

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correlation with wind speed in 2021 but a substantial correlation with PM2.5 concentrations and RH in both years. However, a negative connection between daily COVID-19 instances and wind speed was observed. Wind speed has a significant impact on the ambient environment's ability to diluted and remove droplets, which may diminish the viral burden in the air and, as a result, the spread of Covid-19 (Rosario, 2020). The year 2021 also revealed the similar pattern. In light of this, PCA came to the conclusion that daily COVID-19 instances were closely associated to PM2.5 concentrations, temperature, and relative humidity in 2020 and 2021.

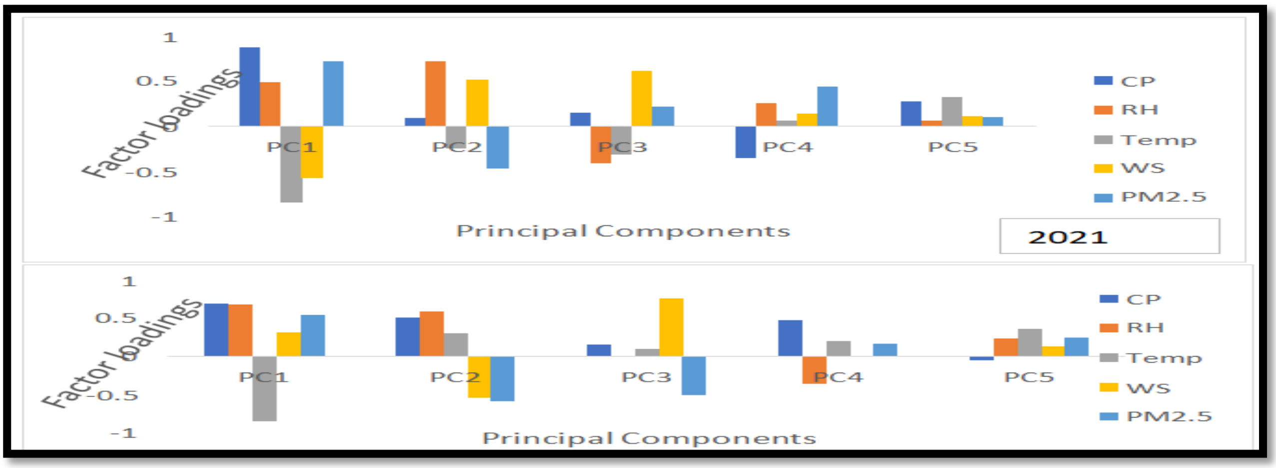

FIGURE 1: FACTOR LOADINGS AFTER VARIMAX ROTATION

Our findings suggest that people may become more susceptible to the COVID-19 infection if they are exposed to high levels of the PM2.5 pollutant. This study shows a strong correlation between Gurugram COVID-19 instances and PM2.5 concentrations. This study found that the conditions for the highest percentage of COVID-19 cases (33%) during the winter were 286.6 g/m3 PM2.5 concentration, 68.265 km/h wind speed, 73.81% RH, and 12.64 °C temperature. While the lowest number of instances of COVID-19 (1.39%) were recorded during the pre-monsoon season at 18.18 g/m3 of PM2.5, 83.295 km/h of wind speed, 50.05% RH, and 10.62 °C of temperature.The effects of PM2.5 suggest that limiting one's exposure will help fight the COVID-19 epidemic. Green environmental solutions should be supported since they will protect those who are susceptible to the Covid-19 pandemic. Additionally, it is recommended that additional analyses and subsequent clinical studies be carried out in other

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regions of Gurugram using reliable procedures to determine the role played by other contaminants in the spread of the COVID-19 pandemic.

- **COVID-19 MECHANISM IN HUMAN BODY**

Through the lips, eyes, or nose, the virus enters the body. Similar to SARS-CoV, the spike protein binds exclusively to the ACE2 receptors found on type 2 pneumocytes in the alveoli of the lungs. Surfactants produced by pneumocytes lower the surface tension in alveoli and lower collapse pressure. Due to host cell proteases that split the virus' spike protein, the engagement of the ACE2 receptor permits the virus to enter the host cell. The virus can enter the host cell directly through membrane fusion or indirectly through endocytosis. There are three stages to the disease's symptoms. In 2020, Kumar et al. Instead, they had an impact on a number of human systems, including: (i) the immune system; (ii) the hematological system (vascular hemostasis; blood coagulation); (iii) the pulmonary system (respiratory failure; pulmonary thromboembolism; pulmonary embolism; pneumonia; pulmonary vascular damage; and pulmonary fibrosis); (iv) the cardiovascular system.

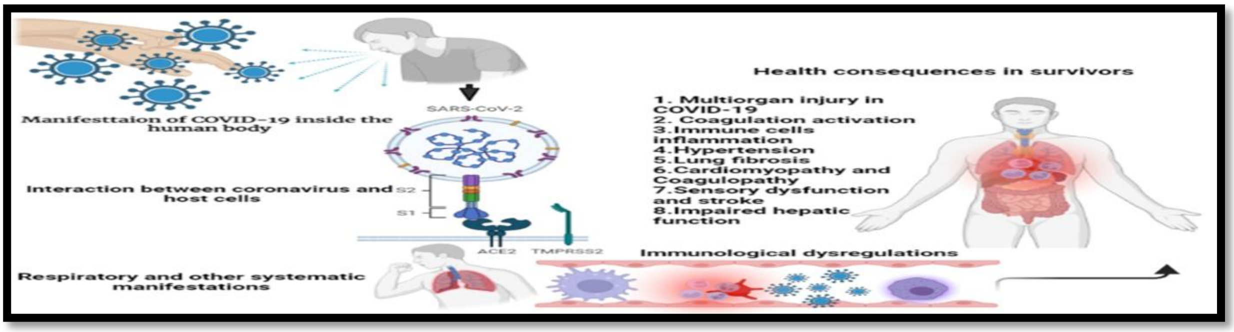

FIGURE2:COVID-19MECHANISMINHUMANBODY.

- **CORONAVIRUSANDHOSTCELLINTERACTION**

Angiotensin-converting enzyme 2 (ACE2), which is encoded by the ACE2 gene, is thought to be a genetic risk factor for SARS-CoV-2 infection and necessary for the virus to enter cells. According to Choudhary et al. (2021) COVID-19 is a respiratory infection that can range in severity from a moderate viral pneumonia to acute respiratory distress syndrome (ARDS), which can result in multi-organ failure. The post-infection control of ACE2 includes immunological response, cytokine release, and viral genome replication in addition to its role

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as a receptor (Fernandez and Swalha 2020). In addition to being crucial for viral susceptibility, ACE2 may also be involved in the control of infections after they have occurred. Additionally, increased expression of ACE2 may speed up virus replication, extend the virus life cycle, and facilitate virus entry into the host cell. The production of the cytokines IL-1, IL-10, and IL-6 increased together with the expression of ACE2 after infection (Li etal., 2020). Evidence suggested that the cytokine storm, which is represented by an unchecked overproduction of soluble indicators of inflammation, is the primary cause of COVID-19 mortality (Cao et al., 2020).

- **Respiratory and other systematic manifestations**

Patients with COVID-19 may present with a variety of clinical symptoms. From asymptomatic patients to severe pneumonia cases that might be fatal, the infection's severity can vary. The initial symptoms of the illness were the trio of fever, coughing, and shortness of breath. The most typical finding among patients was fever (58.66%). The second most frequent symptom was cough (54.52%), which is specifically related to the virus spreading through respiratory droplets. Dyspnea was observed in 30.82% of the patients who were reported, and it is typically associated with conditions that are more severe. Clinical signs of neurological problems (20.82%) are also among the most prevalent. In severe circumstances, patients may experience acute respiratory distress syndrome along with rapid development of respiratory failure, ultimately leading to death. While it is known that COVID-19 primarily affects the pulmonary system, similar to the 2003 severe acute respiratory syndrome (SARS) and the 2012 Middle East Respiratory Syndrome (MERS), the disease's effects also affect other organs of the body.

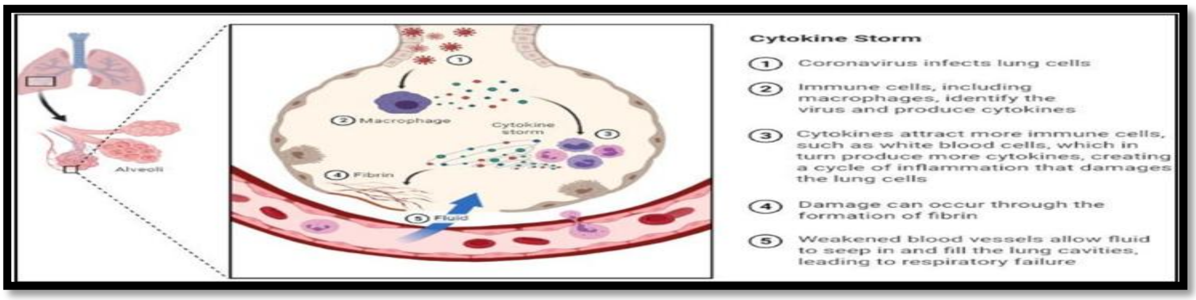

FIGURE3-MECHANISMOFRESPIRATORYFAILUREDUETOCOVID-19.

- **IMMUNOLOGICAL DYSREGULATIONS**

Acute respiratory distress syndrome (ARDS) is a complication of SARS-CoV-2 infection, however recent reports also include people who experience multiorgan failure and thrombosis, including myocardial infarction and ischemic stroke. The likelihood of developing thrombotic problems is higher in patients with cardiovascular risk factors like obesity, diabetes, and hypertension, with 20% to 30% of critically ill COVID-19 patients developing thrombosis after SARSCoV-2 infection. The pathophysiological causes of thrombosis in COVID-19 are yet unknown, despite the fact that thrombotic problems are frequently experienced with SARS-CoV-2 infection. Platelets (and their precursor cells, megakaryocytes) mediate important elements of inflammatory and immunological responses in addition to their traditional function in thrombosis and haemostasis. Similar to innate immune cells, platelets express a wide variety of receptors, such as nucleotide-binding and oligomerization domain-like receptors, C-type lectin receptors, and Toll-like receptors (TLRs). These and other receptors are well known for assisting in the identification of viral infections like dengue, HIV-1, and influenza. After detecting the pathogens, platelets mediate immune responses both directly and indirectly by interacting with neutrophils, monocytes, and lymphocytes and releasing cytokines and antimicrobial peptides to enhance the immune response. The prothrombotic reaction, also known as immunological thrombosis, is frequently linked to inflammatory and infectious diseases because platelet activation frequently happens when platelets react to invading pathogens. Immuno thrombosis may trigger unfavorable immunological and hemostatic processes, which in turn can lead to unfavorable clinical outcomes like organ failure, vascular thrombosis, and mortality.

- C-**REACTIVE PROTEIN (CRP)**

The liver produces the pentameric protein known as C-reactive protein (CRP). Both pro- and anti-inflammatory effects can be attributed to CRP. Through attaching to phosphocholine, phospholipids, histone, chromatin, and fibronectin, it detects and destroys invading infections and injured cells (Cleland &Eranki, 2021). In reaction to inflammation, the acute-phase reactant protein CRP increases. Interleukin (IL)-6 and IL-1 regulate during the acute phase of an inflammatory/infectious process, respectively, and are primarily responsible for inducing CRP by acting on the gene responsible for its transcription (Volanakis, 2001). According to Alamdari et al. (2020), individuals with high body mass index and elevated CRP had a greater chance of dying from the COVID-19 infection. It is clear that CRP may be an important factor in the inflammatory response process; as a result, it can be utilized to determine the severity of COVID-19 and be independently associated with the chance of developing the disease.CRP is typically reported in mg/L with a range of values. For instance, a typical level is less than 0.3 mg/L, which is what most healthy people experience. In people with obesity, pregnancy, depression, diabetes, the common cold, gingivitis, periodontitis, sedentary lifestyle, cigarette smoking, and genetic polymorphisms, the level between 0.3 to 1.0 mg/L is considered a normal or modest elevated range. CRP levels between 1.0 and 10.0 mg/L are regarded as moderately elevated and are associated with systemic inflammation in conditions like RA, SLE, or other autoimmune disorders, cancer, myocardial infarction, pancreatitis, or bronchitis. A noticeable elevation of more than 10.0 mg/L suggests the presence of acute bacterial infections, viral infections, systemic vasculitis, and substantial trauma. A severe elevation of more than 50.0 mg/L suggests the presence of acute bacterial infections.

- **Interleukin-6 (IL-6)**

Monocytes release interleukin-6 (IL-6), a pleiotropic proinflammatory cytokine. Due to its extensive variety of hematological actions and their capacity to initiate the acute phase response, it is a multitasking cytokine that contributes to host defense. The IL-6:IL-6R combination may directly activate cells after IL-6 binds to the IL-6 receptor (IL-6R) on the surface of cells. IL-6 encourages T-cell differentiation and B-cell maturation. It simultaneously promotes systemic inflammatory response by synergizing with TNF-a and IL-1 (Moulton, 2016). According to Talwar et al. (2022) the reference level for normal IL-6 is 1.8 (pg/mL).Elevated levels of acute phase reactants such C-reactive protein, serum amyloid A, fibrinogen, and hepcidin, as well as the suppression of albumin production, are brought on by elevated levels of IL-6 in the blood. IL-6 levels have been proven to be a major predictor of poor clinical outcomes in COVID-19 patients, making it a key indicator of how severe the disease would be. Additionally, IL-6 is a reliable indicator of the progression of a clinical profile and the prognosis of a disease (Shekhawat et al., 2021). The extreme inflammation and chemokine storm that characterize COVID-19 are what cause the level of IL-6 to rise.

- **Haemoglobin (Hb)**

An embedded heme group (iron ion and porphyrin molecule) carries the four globular protein subunits that make up hemoglobin, a protein found in red blood cells. Through the reversible binding of oxygen to the iron ion in heme groups, RBCs transport oxygen from the lungs to the body's tissues. According to Steinberg (2022) the typical reference range for hemoglobin is 11.6–15 grams per decilitre for women and 13.2-16.6 grams per decilitre for men. The pathophysiology of hypoxia in COVID-19 patients may be influenced by a decreased affinity of hemoglobin for oxygen. On the other side, it was found that in COVID-19 patients, elevated Hb levels are linked to inflammation, hypercoagulability, and low SaO2. That could account for the significant mortality rate (27.7%) seen in diabetic patients who also had COVID-19 infections. Inflammation, hypercoagulability, and prognosis of COVID-19 patients can thus be accurately determined by Hb level (Merzon et al., 2021).

- **Platelet Count**

The bone marrow is where platelets, which are small, colorless particles that help clots form and stop bleeding, are produced. White blood cells, red blood cells, and platelets develop from stem cells found in bone marrow. Blood typically contains between 150,000 and 450,000 platelets per microliter. Thrombocytosis is a condition where there are over 450 000 platelets in the blood; thrombocytopenia is when there are less than 150,000 (Ginnakeas et al., 2022). The bone marrow stores extremely few platelets because they have a brief lifespan. The severity of the patient's condition can be sensitively reflected by changes in platelet count in the early stages of the disease. Patients with COVID-19 frequently have changes in platelet count. The pathophysiological alterations in COVID-19 patients can be dynamically reflected by platelet count in the early stages. In patients with COVID-19, an early platelet count decline was linked to mortality (Zhao et al., 2020).

- **Erythrocytes Count**

Red blood cells (RBCs), also known as erythrocytes, carry oxygen and carbon dioxide from the lungs to tissues. RBCs are anucleate, biconcave cells that develop during a process known as erythropoiesis in the red bone marrow. Once discharged into the bloodstream, mature RBCs can live for between 100 and 120 days. The spleen, liver, bone marrow, and lymph nodes' macrophages recycle old RBCs after 120 days. Men's RBC levels should be between 4.7 and 6.1 million cells per microliter (cells/mcL) while women's levels should be between 4.2 and 5.4 million cells/mcL (Prudinnik et al., 2022).One of the targets that SARS-COV-2 damages is erythrocytes. According to Olver's research, EMS and influenza viruses connect to human erythrocytes via the glycophorinA receptor (Olver, 2022). RBC count, hemoglobin, haematocrit, and packed cell volume (PCV) measurements are typically used to quantify erythrocytes (Sutton &Sellon, 2012). Due to higher levels of erythrocytes, hemoglobin, hematocrit, leukocytes, neutrophils, CRP, and D-dimer and lower values of platelets, lymphocytes, monocytes, basophils, and eosinophils count, older patients with hypertension and COVID-19 infection had higher mortality (Harvey 2022).

- **Neutrophils**

The type of white blood cell known as a neutrophil is a component of the immune system and the first cell to fight infection. In blood, neutrophils make up 50%–75% of all circulating leukocytes. They are early responders to pathogens such as bacteria, fungi, and viruses and play a significant role in inflammation. Neutrophils play important roles in homeostasis and are also linked to chronic inflammatory disorders. Through the release of enzymes and poisonous substances, the production of reactive oxygen species, and the release of nuclear material into extracellular traps known as neutrophil extracellular traps (NETs), neutrophils mediate direct antimicrobial actions (Rankin et al., 2020). Although the evidence is sparse, infections with the influenza virus and SARS-CoV-1 caused neutrophils to increase their antiviral defenses by interacting with other immune cell populations, internalizing viruses, killing them, releasing cytokines, degranulating, and producing neutrophil extracellular traps (NETs). Numerous lung conditions linked to ARDS contain neutrophils.Neutrophil activation is also triggered by SARS-CoV2 infection. Recently, research on the polymorphonuclear

(PMN) immunological response brought on by SARS-CoV-2 was conducted. Additionally, it has been stated that in COVID-19 patients, neutrophilia is a sign of severe respiratory symptoms and a non-exceptional result (Silva et al., 2021). Adult neutrophils typically range from 2,500 to 7,000 per microliter (Hedrick and Malanchi, 2022). Due to greater blood levels of neutrophil extracellular traps, elevated neutrophil counts have been seen in individuals with severe COVID-19. According to a recent study (Reusch et al., 2021) neutrophil activation and degranulation are highly activated mechanisms in the SARS infection.

- **Eosinophils**

The eosinophil is a type of white blood cell that promotes inflammation. It has a bilobed nucleus and cytoplasm that is filled with huge granules of enzymes and proteins. When the body is in a homeostatic state, the pool of circulating leukocytes includes just a small subgroup of granulocytes called eosinophils. In the bone marrow, pluripotent progenitor cells differentiate into eosinophils under the influence of many cytokines, such as interleukin (IL- 3, IL-5). Eosinophils aid in the capture of chemicals, anti-parasitic activity, cell-killing, rapid allergic reactions, and inciting inflammatory responses. According to Benson et al. (2002), eosinophils have been identified as a host defense enhancer against the Sendai virus, human immunodeficiency virus, influenza virus, respiratory syncytial virus (RSV), and pneumonia virus.

- **Leukocytes**

Leukocytes are blood cells with a nucleus, the ability to move, and the absence of hemoglobin. Bone marrow produces white blood cells, and organs like the spleen, liver, and kidneys control how much of them are generated at any given time. Monocytes, granulocytes (eosinophils, neutrophils, and basophils), and lymphocytes (T cells and B cells) are examples of leukocytes that make up the immune system. It is crucial to direct leukocytes to the site of an injury or infection, and a complex set of adhesion processes between leukocytes and endothelium makes sure that they only leave the bloodstream at the inflammatory site. Leukocytes adhere to the arterial wall, move down the wall to the endothelial boundaries, cross the endothelium and the subendothelial basement membrane, and then move into the

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interstitial tissue in a series of adhesion stages (Muller, 2013).

- **Basophils**

During the haematopoiesis process, basophils begin as stem cells in the bone marrow and mature into basophils. Bone marrow releases mature basophils that go into the bloodstream (Metz et al., 2013). According to Sicilia et al. (2011), mature basophils have an estimated lifespan of 60–70 hours. Less than 1% of the circulating leukocytes belong to this least prevalent granulocyte population (Doke et al., 2022). In atopic allergy, dermatitis, and autoimmune illnesses as well as acute hypersensitivity syndromes, basophils serve as immune surveillance cells (Gwaltney-Brant, 2014). Histamine is produced by basophils after an asthma attack or other allergic reaction.Mast cells and basophils are two of the main Th2 response inducers and play a key role in allergy and anti-parasitic protective immunity. Interleukin that targets basophils has recently been found as chemokines, the most effective basophil chemo attractants. During an allergic reaction, it increases the release of histamine by IgE-dependent stimuli as well as the basophils' secretion of IL-4, IL-8, and IL-13 (Harvey, 2012).It is known that basophils actively participate in the adaptive immune response to SARS-CoV-2. Through the production of inflammatory chemicals, their activation causes a hyperinflammatory condition that feeds the cytokine storm and, over time, leads to pulmonary fibrosis. The degree of this depletion is a significant determinant of the antibody response to the virus, as basophil quantity is found to be smaller during acute sickness compared to the recovery period. Since their lowering is linked to a worse prognosis, basophil counts may be a valuable predictive tool for COVID-19, according to recent studies (Siracusa et al., 2011). It was mentioned as a potential therapeutic target by Murdaca et al. in order to lessen the airway inflammation that is typical of the hyperacute phase of the disease (Murdaca et al., 2021).

- **D-dimer**

The successive actions of thrombin, factor XIIIa, and plasmin enzymes result in the production of the D-dimer antigen during fibrin formation and fibrinolysis. Initial fibrinogen cleavage by thrombin is followed by polymerization of fibrin monomers, which serve as a template for the synthesis of factor XIIIa and plasmin. The next step in the thrombin reaction is to activate plasma factor XIII, which then binds to fibrin polymers to form factor XIIIa, the active transglutaminase. Factor XIIIa is responsible for catalyzing the development of covalent connections between the D-domains of the polymerized fibrin. The D-dimer antigen is exposed when plasmin destroys the crosslinked fibrin, releasing fibrin degradation products (Soheir et al. 2009).One of the tests performed in patients to look for thrombosis is the D-dimer level. According to Kearon et al. (2022) the reference range for D-dimer is 250 ng/mL, or 0.4 mcg/mL. In the early stages of COVID-19 disease, there is an increase in D-dimer and fibrinogen concentrations; a 3–4-fold increase in D-dimer levels is associated with a bad prognosis. In addition, people with COVID-19 may see a rise in D-dimer levels due to underlying conditions like diabetes, cancer, stroke, and pregnancy. In order to treat and manage COVID-19 disease, it can also be helpful to measure the amount of D-dimer and coagulation parameters at an early stage of the disease. The activation of the plasmin enzyme results in the formation of the D-dimer, which is made up of two D fragments of fibrin. This suggests that a destroyed fibrin is present in the bloodstream. D-dimer is a sign that the coagulation and fibrinolysis systems are active (Li et al., 2020).

- **Pus cells**

Pus is a viscous fluid made up of germs, dead tissue, and cells. The body frequently produces when battling a bacterial illness. According to Edem et al. (2022) the reference value for Pus cells is 0–5 (hpf). According to reports, the greatest buildup of pus and mucus in the alveoli, bronchioles, and bronchi in COVID-19-infected patients is a defining characteristic of severe pneumonia. The respiratory system is fully filled with mucus and pus, depriving the lungs of airiness. Pus and mucus block gas exchange in the lungs and squeeze air out of the respiratory tract, which results in hypoxia and hypoxic injury to brain cells (Zhang et al., 2022).

- **Monocytes**

Initiated from myeloid progenitors in the bone marrow, monocytes are a subpopulation of leukocytes that circulate via the blood to peripheral tissues. The circulating antecedents of macrophages, which play a crucial role in the inflammatory process, are monocytes. Human monocytes are split into two main subgroups (CD14 and CD16), each with a particular characterisation, based on the degree of expression of specific surface markers. According to Kool and Broos (2019), there are three different types of monocyte populations: CD14++ classical monocytes, CD14+CD16+ intermediate monocytes, and CD16++ nonclassical monocytes. The immune system's key immune cells, monocytes and macrophages, are important in the body's fight against viral infections. In order to get rid of pathogens and heal tissue damage, they primarily produce inflammatory mediators in response to the microbial antigens (Meidaninikjeh et al., 2021). Monocytes and macrophages can both become infected by SARS-CoV-2 through ACE2-dependent and -independent mechanisms. Circulating monocytes that are infected can trigger acute inflammatory reactions, a cytokine storm, tissue damage, and mortality by engaging in inappropriate activities (True et al., 2022). According to Howe et al. (2022) the normal reference range for human monocytes is 0.2-1.0(103 cells/L).

- **Lymphocytes**

White blood cells known as lymphocytes are essential in the systemic inflammatory response to serious injury, infection, polytrauma, and shock. There are numerous lymphocytes in the blood, lymph, and lymphoid organs. The thymus and bone marrow, also referred to as the central or primary lymphoid organs, are where lymphocytes are primarily produced. While mature lymphocytes migrate through blood to peripheral or secondary lymphoid organs like lymph nodes, spleens, and epithelium-associated lymphoid tissues in the gastrointestinal tract, respiratory tract, and skin, the majority of lymphocytes die in the central lymphoid organ without ever functioning. T cells and B cells respond to foreign antigens in the peripheral lymphoid organs (Alberts et al., 2002).

- **HealthMeasurements**

The COVID-19 virus has wreaked havoc throughout the world, and Gurugram is set to top the list of nations with the most cases and fatalities. The effectiveness of morbidity and morbidity must therefore be evaluated at all levels, from local to global.As a way to gauge the global burden of disease, the World Bank, which is funded by the World Health Organization, has introduced health metrics (Murray et al., 1996). The global burden of disease (GBD) approaches could take the place of more conventional approaches to health assessment. GBD represents a significant advancement in that it attempts to incorporate death and disability into a single metric and ensures consistent estimates of the worldwide numbers of deaths by cause. The GBD methodologies were used in the current study to analyze the discrepancy between COVID-19-infected individuals' current health status and Gurugram's ideal health outcomes. Through the use of distinct and specially created metrics, such as Healthy Life Expectancy (HALE), Years of Life Lost (YLLs), Years Lived with Disability (YLDs), and Disability-adjusted life years (DALYs), the researchers may be able to compare the health conditions in order to improve global health outcomes.

5. Conclusion

This study has examined the impact of raising the AQI, or PM2.5, on the incidence of suspected and confirmed cases of COVID-19 disease since air pollution is a significant environmental component in the development of viral epidemics. According to the study's findings, stringent laws like curfews and quarantines, adherence to health precautions, teleworking and shorter workdays, and avoiding risky behaviours—especially on days when the AQI is in unhealthy conditions—can all be useful in lowering the number of suspected and confirmed cases. The statistical tests' results demonstrated a positive and substantial correlation between the AQI (in the presence of PM2.5), the referral of suspicious cases to hospitals, and the incidence of positive cases (p-value).

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