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# A Study on Assessing the Impact of Smoking and Occupational Exposure on COPD Severity

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**Abstract**
Chronic Obstructive Pulmonary Disease (COPD) is a leading cause of morbidity and mortality worldwide, with occupational exposure to respiratory hazards and smoking being significant risk factors for its development and progression. This study aimed to investigate the relationship between occupational exposure and COPD severity among patients admitted to the new medical ward of a public hospital. The research employed a cross-sectional design and involved a sample of 160 COPD patients. Data collection included patient records, face-to-face interviews, and structured questionnaires that gathered demographic information, smoking history, occupational exposure, and disease severity. Quantitative analysis methods were used, with statistical tools such as chi-square tests and correlation analysis applied to assess the relationships between variables. The chi-square test demonstrated a significant association between occupational exposure and COPD severity ($\chi^2 = 45.07$, df = 8, p = 0.05). Correlation analysis revealed positive relationships between COPD severity and age (r = 0.40), smoking status (r = 0.53), and duration of occupational exposure (r = 0.69). The findings emphasize the critical role of occupational risks and smoking in exacerbating COPD and suggest the need for preventive workplace interventions and stricter regulations to reduce respiratory hazards.

**Keywords:** COPD, occupational exposure, smoking, disease severity, respiratory hazards, occupational health, correlation, chi-square test.

## 1. Introduction

Chronic Obstructive Pulmonary Disease (COPD) is a progressive respiratory ailment marked by airway inflammation and blockage, resulting in breathing problems, a persistent cough, and other incapacitating symptoms. COPD is a major global health issue that affects millions of individuals and causes considerable morbidity and mortality. Occupational exposures are a key risk factor for COPD, with workplace exposure to airborne pollutants such as dust, fumes, and gases playing a substantial role in the disease's development. There has been an increase in interest in the association between occupational health and COPD in recent years, with a growing body of research studying the influence of workplace exposures on COPD incidence and outcomes. [1] COPD is a severe and sometimes fatal condition that affects over 384 million people globally.[2] It is caused by persistent inflammation of the airways, which results in constriction and obstruction of the airways. The most typical COPD symptoms are shortness of breath, coughing, and wheezing, and they may significantly affect a person's quality of life. COPD is often brought on by prolonged exposure to irritants including cigarette smoke, air pollution, and environmental toxins.

COPD often develops over time as a result of long-term exposure to irritants that cause lung damage.

**1.1 History of COPD**

Tobacco use is the key underlying cause, accounting for the majority of COPD cases. Inhaling cigarette smoke causes inflammation and constriction of the airways, resulting in persistent airflow restriction. This causes structural changes in the lungs over time, such as the death of lung tissue [emphysema] and thickening of the airway walls [chronic bronchitis]. In the 1950s, the first systematic research on COPD was done, leading to a better knowledge of its pathophysiology and clinical aspects. [3]

**1.2 COPD as an Occupational Hazard**

COPD is an important topic of concern in the realm of occupational health since it not only impacts the lives of people but also imposes a significant economic cost on society as a whole. Occupational health is concerned with detecting and reducing threats in diverse workplaces. Physical, chemical, biological, ergonomic, and psychological dangers can all influence the safety and health of employees. [4] A crucial component of occupational health is ensuring a safe working environment. Implementing safety measures, providing adequate personal protective equipment [PPE], and maintaining correct machinery and equipment are all part of lowering the risk of accidents, injuries, and occupational illnesses.[5] The link between COPD and occupational health is complicated and intricate.[6] Occupational exposure to respiratory irritants such as airborne pollutants, dust, gases, and chemicals can raise the chance of getting COPD considerably. Mining, construction, and manufacturing industries have been highlighted as particularly high-risk industries for COPD development because of their exposure to these toxic compounds.[7] The influence of occupational risks on COPD, on the other hand, extends beyond these core industries and includes a larger spectrum of jobs. Prolonged exposure to occupational hazards has been demonstrated in studies to cause both acute and chronic respiratory symptoms, aggravating the evolution of COPD.[8] Furthermore, occupational factors may interact synergistically with other risk factors, such as smoking or genetic predisposition, increasing the likelihood of developing COPD. To avoid the start of COPD and to guarantee early identification and appropriate care for afflicted patients, it is critical to recognize and treat these occupational hazards. [9] Furthermore, the impact of COPD extends beyond the individuals affected to employers, healthcare systems, and society at large. COPD is linked to higher healthcare expenditures, lower productivity, absence at work, and early death. This highlights the critical need for a complete knowledge of the relationship between occupational health and COPD to create effective preventative methods, enhance workplace conditions, and reduce the disease's economic and social costs. Occupational exposures to dust, fumes, and gases are also significant factors in the disease's development. Exposure to toxic chemicals at work can harm the lungs by causing persistent inflammation and oxidative stress.[10] These processes cause structural alterations in the airways and alveoli, leading to COPD. Different types of dust, fumes, and gases can cause different patterns of lung damage, but they are all linked to an increased risk of 6 NSHM Knowledge Campus, Kolkata COPD.[11] Workers in some sectors and vocations are more likely to acquire COPD as a result of exposure to toxic chemicals. COPD can be caused by exposure to silica dust, coal dust, and diesel exhaust gases in the mining sector.[12] Construction workers are at risk of getting COPD as a result of exposure to silica dust, cement dust, and asbestos.[13] Manufacturing employees, particularly those in the metalworking and textile sectors, are at risk of getting COPD due to chemical and metal vapours and dust.[14]

The study was conducted with 160 COPD patients admitted in the hospital. It was a cross-sectional study. Using a pre-made questionnaire, structured interviews were performed with the individuals. The length of the study was 3 months i.e., from February 2023 to April 2023. Patients were informed about the study's

purpose, procedures, and their rights to participate or withdraw at any time. All information was analyzed and stored securely, and the privacy of the patient's data was maintained.

## 2. Aims & Objectives

The primary objective of this study was to evaluate the association between occupational exposure and smoking history with the severity of COPD among patients admitted in that hospital during the study period. The study aimed to identify the specific nature and duration of respiratory risks and irritants to which patients were exposed and assess how these factors influence disease progression. Additionally, it sought to examine the demographic characteristics of the patients, such as age and gender, to better understand the population at risk.

## 3. Literature Review

Studies have found a higher prevalence of COPD in people who work in hazardous environments. [15] Research done among construction workers discovered that the prevalence of COPD was substantially greater than in the general population.[16] Similarly, a study found that exposure to cotton dust and chemical dyes increased the incidence of COPD in textile workers. [17] Occupational exposure to a variety of respiratory risks has been recognized as a critical risk factor for COPD. Due to exposure to coal dust and silica particles, mining, particularly coal mining, has been linked to an increased risk of developing COPD [18]. Similarly, agricultural workers exposed to agricultural dust, pesticides, and fertilizers have a higher chance of developing COPD [19]. Exposure to dust, chemicals, and airborne infections has also been associated with COPD development in other industries such as construction, manufacturing, and healthcare [20]. The processes through which occupational exposures contribute to COPD development have been studied. According to research, inhaling particulate matter and chemical compounds causes airway inflammation, oxidative stress, and lung tissue damage [21]. Occupational exposures can also combine with genetic susceptibility factors such as alpha-1 antitrypsin deficiency, increasing the chance of developing COPD [22]. Several studies have emphasized the significance of intervention and prevention strategies in lowering the burden of COPD as an occupational health disease. Workplace treatments such as better ventilation, engineering controls, and proper personal protective equipment [PPE] have been proven to minimize the incidence of occupational COPD [23]. Occupational health training programs that promote correct PPE usage and raise knowledge about respiratory dangers have also been helpful [24]. Several studies have looked into the effect of occupational exposures on lung function in people with COPD. A study investigated the reduction in lung function in factory employees exposed to dust and pollutants.[25] Long-term exposure resulted in a considerable decrease in FEV1 and forced vital capacity FVC.[26] Similarly, a study discovered a strong link between occupational exposures and accelerated lung function decrease in construction workers, showing the negative impact of job risks on respiratory health. [27] Several studies have found that patients who have occupational asthma are more likely to develop COPD over time. [28]. COPD as an occupational health illness has a considerable worldwide burden. According to the World Health Organization, occupational variables account for around 15% of all COPD cases globally [29].

## 4. Methodology

### 4.1 Research Design

To investigate the relationship between the severity of Chronic Obstructive Pulmonary Disease (COPD)

and two main risk factors—smoking history and occupational exposure—the study used a cross-sectional, observational research approach. The study focused on 160 patients with COPD diagnoses and was carried out at the new Medical Ward of a public hospital

### 4.2 Population and Sampling

Patients with COPD who were admitted during the research period made up the study population. Hospital medical records were used to identify these people, and inclusion criteria were used to make sure that participants had a verified diagnosis of COPD. The 160 patients in the final sample are those who qualify for the study on the chosen ward.

### 4.3 Data Collection

- **COPD Severity and medical history:** Data were collected using a combination of medical record reviews and consultations with the treating doctors, The Global Initiative for Chronic Obstructive Lung Disease (GOLD) criteria, which classify the illness into phases according to airflow limitation as determined by spirometry (FEV1), were used for evaluating the severity of COPD. Medical records and discussions with treating physicians, who offered important insights into the patient's clinical care, spirometry findings, and general health, were used to gather data on the severity of COPD and the present medical condition. The doctors' experience and clinical records confirmed each patient's GOLD stage, which further deepened our awareness of the disease's severity.
- **Smoking History and Occupational Exposures:** Information on smoking history was gathered solely through structured interviews with the patients. Occupational history, including the nature and duration of exposure to respiratory hazards, was also collected during the interviews. The interviews were designed to ensure clarity and straightforwardness, allowing patients to share their histories comfortably.

### 4.4 Data Analysis

Upon completing the data collection process, the interview responses and notes were compiled and organized for analysis. Both quantitative and qualitative analysis methods were employed, depending on the nature of the information gathered.

Statistical methods were used to analyse the quantitative data from structured interview questions. The data was summarised using descriptive statistics including means, standard deviations, frequencies, and percentages. Additionally, statistical tests including the correlation analysis and chi-square test were used to look at relationships between variables, specifically between the severity of COPD and smoking history and occupational exposures. The study was carried out using statistical tools like SPSS (Statistical Package for Social Sciences), which guaranteed accuracy in spotting important connections and trends.

### 4.5 Ethical Considerations

Informed consent was sought from all participants, emphasizing their right to voluntary participation, confidentiality, and privacy. The purpose of the research, the interview format, and the confidentiality of the participant's responses were explained to them. Participants were assured that they could withdraw from the study without facing any negative consequences.

## 5. Results and Findings

The data obtained from observing the medical records and analyzing the responses from the questionnaire were presented in tabular form with frequencies and percentages. Bar charts and pie charts were used to depict the findings. Statistical tests were performed based on the findings.

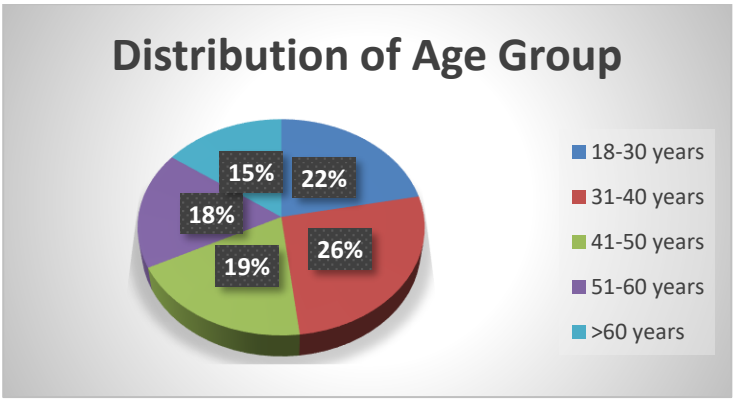
### 5.1 Demographic Characteristics

**Table 1: Frequency table for age**

| Age Group | Frequency | Percentage |
|---|---|---|
| 18-30 years | 35 | 21.88% |
| 31-40 years | 42 | 26.25% |
| 41-50 years | 31 | 19.38% |
| 51-60 years | 28 | 17.50% |
| >60 years | 24 | 15.00% |

The table shows the frequency and percentage of respondents in a survey categorized by age as demographic characteristics. Regarding age, the majority of respondents fall into the 31-40 years age group (26.25%), followed by the 18-30 years age group (21.88%). The 41-50 years age group and the 51-60 years age group has the lowest frequency at 15.00%

**Fig 1: Pie- chart showing distribution of Age**




### 5.2 Severity of COPD of the Respondents

To analyze the severity of COPD among the 160 patients, it was necessary to look at their FEV1 values, which are a measure of lung function. According to the GOLD (Global Initiative for Chronic Obstructive Lung Disease) recommendations, which employ the following categories, the severity of COPD can be categorized as follows:

- GOLD 1: mild COPD, FEV1 ≥ 80% predicted
- GOLD 2: moderate COPD, FEV1 50-79% predicted
- GOLD 3: severe COPD, FEV1 30-49% predicted
- GOLD 4: very severe COPD, FEV1 less than 30% predicted [30]

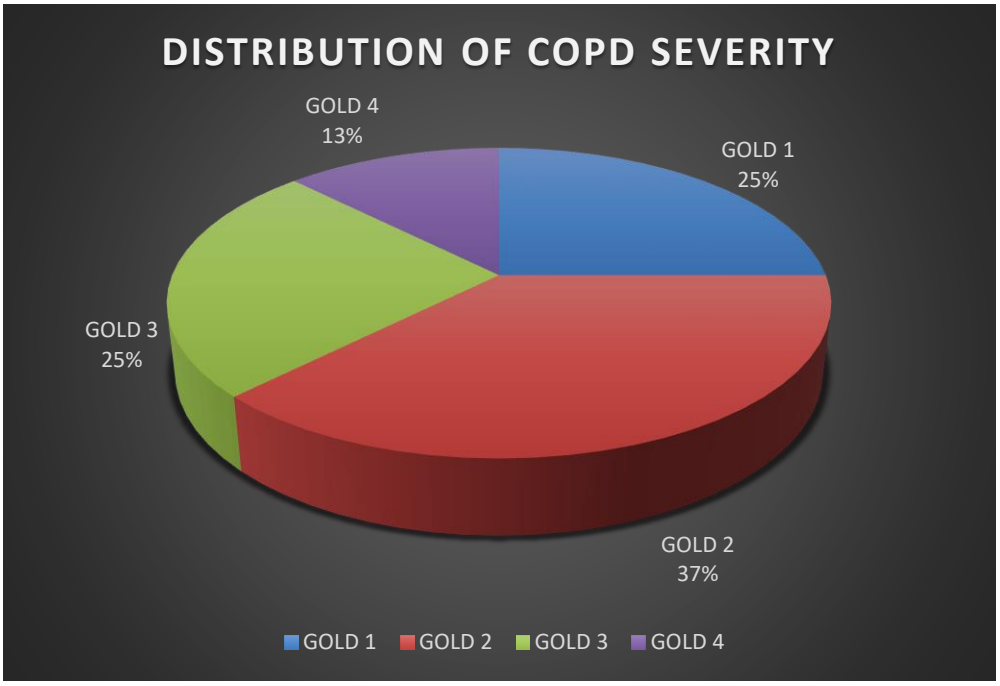
**Table 2: Frequency table for COPD severity**

| COPD Severity | Number of Patients | Percentage of Patients |
|---|---|---|
| GOLD 1 | 40 | 25.0% |
| GOLD 2 | 60 | 37.5% |
| GOLD 3 | 40 | 25.0% |
| GOLD 4 | 20 | 12.5% |

This table shows that the majority of patients (62.5%) have either mild or moderate COPD, while a smaller

percentage (37.5%) have severe or very severe COPD. It's worth noting that these numbers are based on our assumed distribution of FEV1 values, and may vary depending on the actual data.

**Fig 2: Pie chart showing the frequency of COPD severity**




### 5.1.3 Medical History

**Table 3: Frequency of medical history of patients**

| Medical History | Number of Patients |
|---|---|
| Hypertension | 70 |
| Diabetes | 40 |
| Cardiovascular Disease | 25 |
| Asthma | 20 |
| Cancer | 15 |
| Chronic Kidney Disease | 10 |
| Other | 10 |

The table shows the number of patients with different medical histories.

The most common medical condition among the patients is hypertension, with 70 patients having this condition. Diabetes is the second most common condition, with 40 patients. Cardiovascular disease and asthma have lower frequencies with 25 and 20 patients, respectively. Cancer and chronic kidney disease have even lower frequencies, with 15 and 10 patients, respectively. There are also 10 patients with other medical conditions not specified in the table.

### 5.1.4 Smoking History

Out of the 160 patients, 48 (30%) have never smoked, 63 (39.4%) are current smokers, and 49 (30.6%) are former smokers. The majority of patients in this sample have either been a current smoker or a former smoker, with a slightly higher percentage of current smokers. Only 30% of patients have never smoked.

**Table 4: Number and percentage of patients with Smoking History**

| Smoking History | Number of Patients | Percentage |
|---|---|---|
| Never Smoked | 48 | 30% |
| Current Smoker | 63 | 39.4% |
| Former Smoker | 49 | 30.6% |
| Total | 160 | 100% |

### 5.1 Occupational Exposure

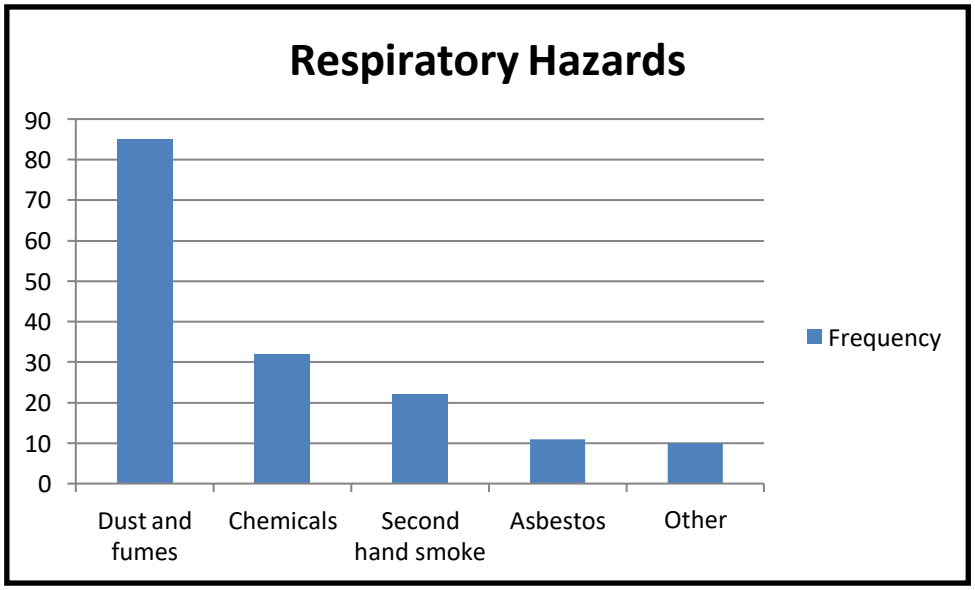
#### 5.1.1 Types of Respiratory Hazards

The most common respiratory hazard reported by the respondents is dust and fumes, with a frequency of 85 (53.1%). Chemicals are the second most common respiratory hazard, with 32 respondents (20.0%) reporting exposure to them. Second-hand smoke is reported by 22 respondents (13.8%), while asbestos exposure is reported by 11 respondents (6.9%). Finally, 10 respondents (6.3%) reported exposure to other types of respiratory hazards not specified in the table

**Table 5: Frequency of respiratory hazards**

| Types of Respiratory Hazards | Frequency | Percentage |
|---|---|---|
| Dust and fumes | 85 | 53.1% |
| Chemicals | 32 | 20.0% |
| Second-hand smoke | 22 | 13.8% |
| Asbestos | 11 | 6.9% |
| Other | 10 | 6.3% |

**Fig 3: Bar chart showing frequency for respiratory hazards**



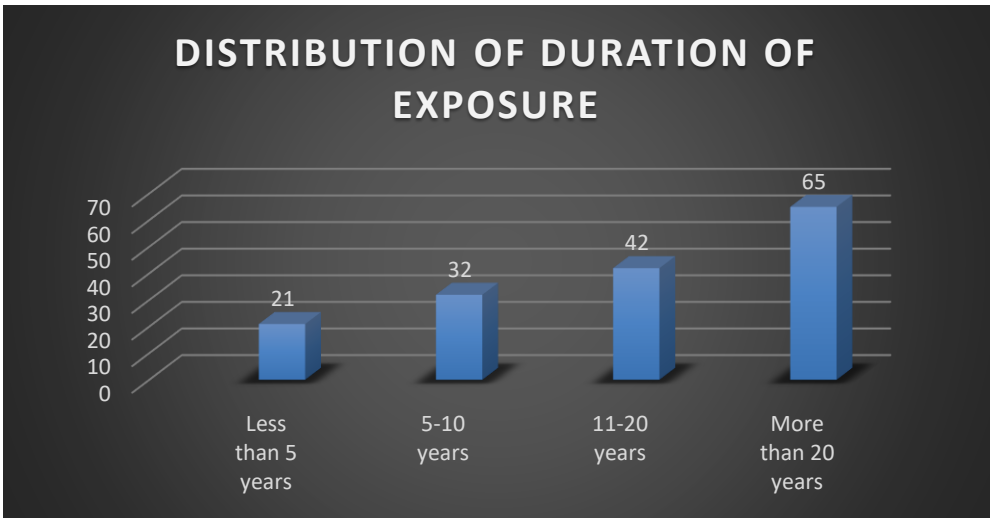
### 5.1.2 Duration of Exposure

**Table 6: Frequency table for duration of exposure**

| Duration of exposure | Frequency | Percentage |
|---|---|---|
| Less than 5 years | 21 | 13.1% |
| 5-10 years | 32 | 20% |
| 11-20 years | 42 | 26.3% |
| More than 20 years | 65 | 40.6% |

The table shows the frequency and percentage of respondents by the duration of their exposure to the respiratory hazards.

**Fig 4: Bar chart showing the duration of exposure to respiratory hazards**




Most respondents 65 (40.6%) reported exposure to respiratory hazards for more than 20 years. The next highest frequency is 11-20 years of exposure, with 42 respondents (26.3%). 20% of respondents reported exposure for 5-10 years, while only 13.1% reported exposure for less than 5 years.

### 5.2 Chi-Square test between COPD severity and smoking history

The Chi-Square Test is a statistical test that determines if there is a significant link or relationship between two categorical variables. It compares the observed frequencies in distinct categories to the anticipated frequencies in the absence of a link between variables.

A Chi-Square test was performed to test if there is a significant association between COPD severity and smoking history.

**Null Hypothesis ($H_{01}$):** There is no significant association between COPD severity and smoking history

**Alternative Hypothesis ($H_{11}$):** There is a significant association between COPD severity and smoking history.

**Table 7: Chi-Square Table between COPD severity and smoking history**

| Statistical Tools | | Values |
|---|---|---|
| COPD severity | Chi-square | 15.16 |
| | df | 2 |
| | Sig. | 0.05 |

Given the test's significance level (p-value) of 0.05 and the Chi-Square value of 15.16 with degrees of freedom 2, it can be concluded that there is a statistically significant relationship between smoking and the severity of COPD.

**5.4 Chi-square test between COPD severity and Occupational Exposure to Respiratory Hazards.**

A Chi-Square Test was conducted to test if there is a significant association between COPD severity and occupational exposure to respiratory hazards.

**Null Hypothesis ($H_{02}$):** There is no significant association between occupational exposure and COPD severity. In other words, the severity of COPD is independent of the occupational exposure experienced by the patients.

**Alternative Hypothesis ($H_{12}$)**: There is a significant association between occupational exposure and COPD severity**.** In other words, the severity of COPD is related to or dependent on the occupational exposure experienced by the patients.

**Table 8: Chi-Square Table between COPD Severity and Occupational Exposure to Respiratory Hazards.**

| Statistical tools | | Values |
|---|---|---|
| **COPD severity** | Chi-square | 45.07 |
| | df | 8 |
| | Sig. | 0.05 |

Observed that the chi-square value is 45.07, we can reject the null hypothesis. This indicates that there is a significant association between COPD severity and occupational exposures. The results indicate that occupational exposures are likely to have a considerable influence on the severity of COPD in individuals. Workers who have been exposed to occupational respiratory dangers for an extended period may be more likely to acquire severe types of COPD. As a result, workplace safety initiatives, protective measures, and limiting hazardous occupational exposures should be prioritized in the management and prevention of COPD.

**5.5 Correlation between the variables**

**Table 9: Correlation Table between the variables.**

| Variables | Age | mokingHistory | )uration ofExposure | COPD Severity |
|---|---|---|---|---|
| **Age** | 1.00 | 0.12 | 0.34 | 0.40 |
| **Smoking History** | 0.12 | 1.00 | 0.48 | 0.53 |
| **Duration of Exposure** | 0.34 | 0.48 | 1.00 | 0.69 |
| **COPD Severity** | 0.40 | 0.53 | 0.69 | 1.00 |

The table presents the correlation coefficients between the variables: Age, Smoking Status, Duration of Exposure, and COPD Severity.

**Correlation Coefficients between Variables:**

**Age and Smoking History: 0.12**

A weak positive correlation. This suggests a slight relationship between age and smoking history, but it is not very strong.

**Age and Duration of Exposure: 0.34**

A moderate positive correlation. This suggests that as age increases, the duration of exposure to occupational risks also increases to a certain degree.

**Age and COPD Severity: 0.40**

A moderate positive correlation. This suggests that older individuals are likely to have more severe COPD, though the correlation is not very strong.

**Smoking History and Duration of Exposure: 0.48**

A moderate positive correlation. This indicates that individuals who have smoked for longer or who are current smokers also tend to have longer durations of exposure to respiratory risks.

**Smoking History and COPD Severity: 0.53**

A moderate-to-strong positive correlation. This suggests that smoking status is quite strongly related to the severity of COPD. Smokers or those with a history of smoking tend to have more severe COPD.

**Duration of Exposure and COPD Severity: 0.69**

A strong positive correlation. This indicates that the longer a patient has been exposed to occupational risks, the more severe their COPD is likely to be.

According to the correlation study, two important characteristics that are linked to the severity of COPD are smoking history and length of exposure to occupational hazards. Age and the severity of COPD are somewhat correlated, but exposure duration appears to have the most impact, followed by smoking history. To manage and prevent severe instances of COPD, interventions that prioritize smoking cessation and lowering exposure to respiratory hazards may be crucial.

## 6. Conclusion

The purpose for this research study is to note the association between the exposure to respiratory hazards that occurred at work and the severity of Chronic Obstructive Pulmonary Disease (COPD) among the patients admitted in that public hospital during the study period. This study also examined the association between smoking and COPD severity among the studied patients. The results of the chi-square test showed a significant association between occupational exposure and the severity of COPD, with a chi-square value of 45.07, and 8 degrees of freedom, at P = 0.05. This means that patients with higher exposure levels to respiratory irritants at work are prone to develop severe forms of the disease. In addition, correlation analysis among major variables indicated that the severity of COPD was positively and statistically significantly correlated with age (r = 0.40); smoking history (r = 0.53); and the duration of exposure(r = 0.69), where the strongest relationship was found between the duration of exposure and the severity of COPD. These data have underlined the multi-factorial nature of COPD, from lifestyle factors such as smoking to occupational risks in the form of long-term exposure to respiratory hazards at work. Occupational exposure shows a good correlation with the extent of disease. Thus, this study enlightens the need for preventive measures in the workplace to reduce exposure to respiratory irritants and thus, the disease burden. Stricter regulations in the workplace, promotion of protective equipment, and regular health check-ups among workers exposed to hazardous environments may make significant contributions toward controlling COPD progression. In general, the study allows for much evidence regarding the

influence of occupational exposure on COPD severity and reinforces the need for occupational health strategies to be integrated into disease management and prevention.

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