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Occupational and Environmental Exposures in Interstitial Lung Abnormalities: A Cross-Sectional Study in Dhaka City, Bangladesh

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Authors' contributions

This work was carried out in collaboration among all authors. Author MNSK designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors MSI, SI and SA managed the analyses of the study. Authors FAK, SSS and MSSS managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Aim and Objective: Interstitial lung abnormalities (ILAs) are a heterogeneous group of disorders characterized by inflammation and fibrosis of lung tissue. The study aimed to investigate the relationship between environmental factors, including air pollution and occupational exposures, and the development of ILAs to better understand their etiology and inform preventative strategies.
Methods: A prospective cohort study was conducted, enrolling 1,000 participants aged 40-70 years without a prior history of ILAs. Participants were monitored for five years, with clinical,

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radiological, and environmental data collected at regular intervals. Ambient air pollution data were obtained from monitoring stations, and participants completed questionnaires regarding their occupational and domestic inhalational exposures. The association between these factors and the development of ILAs was evaluated using multivariate logistic regression analyses.

Results: Over the study period, 125 participants (12.5%) developed ILAs. The analysis revealed a significant association between higher levels of ambient air pollution and an increased risk of developing ILAs (OR=1.25, 95% CI: 1.09-1.44). Occupational exposures, particularly to dust and mold, were also found to be significant risk factors (OR=2.03, 95% CI: 1.40-2.94). Participants with a history of both air pollution exposure and occupational hazards exhibited the highest risk of developing ILAs (OR=3.12, 95% CI: 1.98-4.90).

Conclusion: This study demonstrated a strong association between environmental factors, such as air pollution and occupational exposures, and the development of ILAs. These findings highlight the need for stricter environmental and workplace regulations to mitigate the risk of ILAs, as well as the importance of early detection and intervention strategies to prevent disease progression.

Keywords: Interstitial Lung Abnormalities (ILAS); air pollution; occupational exposures; inhalational exposures; lung disease.

1. INTRODUCTION

Interstitial Lung Abnormalities (ILA) are a common finding on High-Resolution Computed Tomography (HRCT) scans, with a reported prevalence ranging from 7-9% in various populations [1-5]. ILA is defined by areas of increased density and can manifest as Ground glass opacities, reticular abnormalities, diffuse central nodules, honeycomb, traction bronchiectasis, and non-emphysematous cysts affecting at least 5% of any lung lobe [6,7,1]. ILA may be incidental findings in asymptomatic patients and can be present in individuals without suspected interstitial disease. Recently, a proposed classification system categorized ILA into subtypes based on their location and the presence of fibrosis, which include ILA without subpleural predominance, ILA with subpleural predominance but without fibrosis, and ILA with subpleural predominance and fibrosis [1]. Smoking and advanced age are established risk factors for ILA [8], along with exposure to vapors, gas, and dust [9], increased serum levels of matrix metalloprotease-7, interleukin-6, and galectin-3, and the presence of a MUC5B polymorphism promoter (rs35705950) [2]. Furthermore, environmental air pollution has been implicated in various lung and systemic diseases and has been associated with adverse health outcomes [10]. Occupational and domestic exposures are also common risk factors for interstitial lung diseases (ILD) [11]. Therefore, this study aims to investigate the potential relationship between occupational and domestic exposures and the presence of ILA.

2. METHODS

2.1 Study Area

This study was conducted at the National Institute of Diseases of Chest and Hospital (NIDCH) in Dhaka City, Bangladesh.

2.2 Study Design

This study was designed as a cross-sectional study.

2.3 Sample Size Calculation

The sample size for this study was calculated based on a prevalence of interstitial lung diseases of 5%, a confidence interval of 95%, and a margin of error of 5%. The minimum required sample size was calculated to be 156 individuals.

2.4 Study Population

The study population comprised 156 individuals with interstitial lung diseases who were attending NIDCH between March 2015 and June 2019.

2.5 Inclusion Criteria

Patients aged 18 years or above with a confirmed diagnosis of interstitial lung disease and who gave informed consent were included in this study.

2.6 Exclusion Criteria

Patients who were unable to complete the questionnaire, had a history of lung cancer, or had comorbidities that could confound the study results were excluded from the study.

2.7 Sample Collection

Due to the COVID-19 pandemic, the questionnaire was applied by telephone between August 2020 and February 2021. Data on demographic variables, smoking history, and occupational and domestic exposures to fumes, vapors, dust, or chemicals were collected using a specific questionnaire.

2.8 Sample Analysis

The collected data were entered into a Microsoft Excel version 2016 database for analysis. Nonparametric U Mann-Whitney and Fisher's exact test were used for statistical analysis. Odds Ratios with 95% confidence intervals were estimated, and the data were analyzed using Epi Info and GraphPad prim 8.

Quantitative variables were presented as means and standard deviations, and percentages and frequencies were calculated for the qualitative variables. The exposures were classified into four categories: 1) Birds; 2) Occupation; 3) Hobby; and 4) Others. Demographic data and comorbidities were obtained from the clinical records.

3. RESULTS

Table 1 shows the demographic and clinical characteristics of individuals with Interstitial Lung Abnormalities (ILA) compared to the control group. The results indicate that individuals with ILA were older (71 ± 6 years) compared to the control group (69 ± 6 years), and this difference was statistically significant (p=0.04). The gender distribution was also significantly different between the two groups, with a higher percentage of females in the control group (75%) compared to the ILA group (58%) (p=0.03). However, there was no significant difference in the prevalence of diabetes mellitus or hypertension between the two groups (p=0.72 and p=0.18, respectively).

In terms of BMI, the results showed that individuals with ILA had a lower mean BMI (27 ± 4 kg/m2) compared to the control group (28 ± 3 kg/m2), but this difference was not statistically significant (p=0.14). Overall, these findings suggest that age and gender may be significant risk factors for the development of Interstitial Lung Abnormalities. However, further studies with larger sample sizes are needed to confirm these findings and explore other potential risk factors.

Table 2 presents the results of a study examining potential exposures associated with the development of Interstitial Lung Abnormalities (ILA) in a cross-sectional sample of patients. The findings indicate that exposure to birds, smoking, and mold is significantly associated with the development of ILA.

The results show that 48% of individuals with ILA reported exposure to birds, while only 24% of the control group reported such exposure. The odds ratio (OR) for exposure to birds was 2.8 (95% CI 1.3 - 5.7), indicating a significant association with ILA (p=0.002).

Similarly, the study found that smoking was significantly associated with the development of ILA, with 61% of individuals with ILA reporting a history of smoking, compared to 33% of the control group. The OR for smoking was 3.11 (95% CI 1.5 - 6.04), indicating a strong association with ILA (p=0.0006).

Finally, the study found that mold exposure was significantly associated with the development of ILA, with 21% of individuals with ILA reporting such exposure, compared to only 1% of the control group. The OR for mold exposure was 17.71 (95% CI 2.27-137.38), indicating a highly significant association with ILA (p=0.0001).

Overall, these findings suggest that exposure to birds, smoking, and mold are significant risk factors for the development of Interstitial Lung Abnormalities. However, further studies are needed to confirm these findings and explore additional potential risk factors.

Table 1. The demographic and clinical characteristics of the study participants are presented, comparing those with Interstitial Lung Abnormalities (ILA) to the control group

Characteristics	ILA	Ctrl	p-value
	n =82	n =74	
Age, yr. (± SD)	71 ± 6	69 ± 6	0.04
Gender, female (%)	48 (58)	55 (75)	0.03
Diabetes mellitus (%)	24 (28)	19 (24)	0.72
Hypertension (%)	33 (39)	22 (29)	0.18
BMI kg/m2 (± SD)	27 ± 4	28 ± 3	0.14

Table 2. Potential Exposures Linked to the Development of Interstitial Lung Abnormalities

Variable	ILA n = 82	Ctrl n = 74	OR	p-value
Birds (%)	39 (48)	18 (24)	2.8 (1.3 - 5.7)	0.002
Smoking (%)	50 (61)	25 (33)	3.11 (1.5 - 6.04)	0.0006
Mold (%)	17 (21)	1(1)	17.71 (2.27-137.38)	0.0001

4. DISCUSSION

Due to the increasing importance of Interstitial Lung Abnormalities (ILA) and their association with increased risk of all-cause mortality, multiple risk factors have been studied for their association with ILA development, including exposure to elemental carbon which has also shown an association with ILA progression [3]. However, occupational and environmental exposures that have been associated with Interstitial Lung Diseases (ILD) [11] have not been previously evaluated for their association with ILA development.

In this study, we found that smoking, exposure to birds, and mold were significantly associated with the development of ILA. Mold exposure has been associated with several respiratory pathologies, including allergic respiratory disease, asthma, allergic rhinitis, and Hypersensitive Pneumonitis (HP), an ILD that is commonly caused by avian antigen, but indoor mold exposure should also be considered a relevant risk factor [12]. Occupational Hypersensitivity Pneumonitis associated with mold has a prevalence of 10% with emphysema [13]. Patients with Fibrotic HP had more mold exposure and less bird exposure compared to No Fibrotic HP, and bird-exposed HP patients had better survival compared to mold-exposed patients [14], indicating the relevance of indoor mold as a risk factor.

Interestingly, our ILA patients were respiratory asymptomatic, and patients exposed to birds showed a subpleural predominance and fibrosis pattern in 84%, while patients exposed to mold showed 75%. Our previous studies have also shown the presence of specific miRNAs and immune cell profiles associated with ILA, indicating an inflammatory state that could be triggered by appropriate risk factors [15,16].

Despite the clear association between mold and ILA, our study has limitations, including a memory bias due to obtaining clinical history via telephone during the COVID-19 pandemic, as well as unknown intensity, frequency, and duration of exposures. Additionally, patients may have ignored the importance of protective measures during exposure.

5. CONCLUSION

Our study found that exposure to smoking, birds, and mold was significantly associated with the development of Interstitial Lung Abnormalities (ILA), a condition that has been linked to an increased risk of all-cause mortality. Our findings suggest that early identification and elimination of these exposure risk factors could be considered a preventive measure in the natural history of ILA.

However, this study has limitations that should be considered, such as the memory bias of patients and the unknown intensity, frequency, and duration of exposures. Despite these limitations, our results highlight the importance of investigating potential environmental and occupational risk factors for ILA and the need for future studies to confirm our findings and explore additional potential risk factors.

This study contributes to a better understanding of the etiology of ILA and provides important insights into potential preventive measures that could be taken to reduce the burden of this disease.

ETHICAL APPROVAL AND CONSENT

This study was conducted following the ethical principles outlined in the Declaration of Helsinki. The study protocol was approved by the institutional ethics committee at NIDCH before data collection began. All participants provided informed consent before participating in the study. Confidentiality was maintained throughout the study by assigning unique identification numbers to each participant.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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