Occupational Exposure to Vapors, Gases, Dusts, and Fumes Is Associated with Small Airways Obstruction

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Various studies have shown that occupational exposures to vapors, gases, dusts, and fumes is associated with small airways obstruction (1). Moreover, some small-scale studies in specific occupational agents, we additionally adjusted the analyses on the composite measure VGDF, biological dust, mineral dust, gases, and fumes for co-exposure to pesticides, and conversely the analyses on pesticides, herbicides, and insecticides were adjusted for co-exposure to the composite measure VGDF (3).

Of the total of 11,851 subjects, 42% were male, median age being 47 years (range, 18–89 yr), 57% being ever-smokers (median number of pack-years, 10; range, 0–100). Mean FEV₁ % predicted (log) pack-years. Because of substantial co-exposure between the specific occupational agents, we additionally adjusted the analyses on the composite measure VGDF, biological dust, mineral dust, gases, and fumes for co-exposure to pesticides, and conversely the analyses on pesticides, herbicides, and insecticides were adjusted for co-exposure to the composite measure VGDF (3). Exposure to the composite measure VGDF, and to the subcategories biological dust and gases and fumes, was associated with lower FEF₂₅–₇₅ values (Table 1). These associations remained present when we restricted our analysis to subjects without large airways obstruction (Table 1). Moreover, findings were similar in ever- and in never-smokers (Figure 1) and when adjusted for FVC. Occupational exposure to pesticides in general and to the subcategories herbicides and insecticides tended to be associated with lower FEF₂₅–₇₅ in the whole group, yet these associations largely disappeared when the analysis was restricted to subjects without large airways obstruction (Table 1).

It is known that occupational exposure to vapors, gases, dusts, and fumes affects large airway function and increases the risk for spirometry-defined COPD (1–3, 11, 12). With the present letter we add to this knowledge by showing that the small airways are affected by occupational exposure to the composite measure VGDF, and also to the subcategories biological dust, gases, and fumes. Importantly, we find these associations in subjects with normal FEV₁/FVC and FEV₁ % predicted values as well, indicating
that effects of exposure to vapors, gases, dusts, and fumes on the small airways are a primary response and independent from effects on the large airways. The observed associations were found to be independent of smoking habits, which is in contrast to our previous findings on large airways obstruction, where we found significant differences between ever-smokers

**Table 1:** Associations between Occupational Exposures and Level of FEF$_{25-75}$ (ml/s) for the Whole Sample and for Subjects without Large Airways Obstruction (FEV$_1$/FVC $\geq$ 70%, FEV$_1$ $\geq$ 80%)

<table>
<thead>
<tr>
<th>Exposure*</th>
<th>b (95% CI)</th>
<th>P Value</th>
<th>n (%)</th>
<th>b (95% CI)</th>
<th>P Value</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>VGDF</td>
<td></td>
<td>All (n = 11,851)</td>
<td>Without large airways obstruction (n = 9,876)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nonexposed</td>
<td>Ref.</td>
<td>6,534 (55)</td>
<td>Ref.</td>
<td>5,513 (56)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>-47 (-83; -10)</td>
<td>0.012</td>
<td>3,985 (34)</td>
<td>-39 (-74; -4)</td>
<td>0.031</td>
<td>3,325 (34)</td>
</tr>
<tr>
<td>High</td>
<td>-157 (-220; -93)</td>
<td>&lt;0.001</td>
<td>1,332 (11)</td>
<td>-102 (-166; -39)</td>
<td>0.001</td>
<td>1,038 (11)</td>
</tr>
<tr>
<td>Biological dust</td>
<td>Ref.</td>
<td>8,127 (69)</td>
<td>Ref.</td>
<td>7,907 (80)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>-62 (-108; -15)</td>
<td>0.009</td>
<td>1,924 (16)</td>
<td>-38 (-83; 8)</td>
<td>0.104</td>
<td>1,551 (16)</td>
</tr>
<tr>
<td>High</td>
<td>-69 (-182; 24)</td>
<td>0.148</td>
<td>538 (5)</td>
<td>12 (-79; 104)</td>
<td>0.790</td>
<td>418 (4)</td>
</tr>
<tr>
<td>Mineral dust</td>
<td>Ref.</td>
<td>7,007 (59)</td>
<td>Ref.</td>
<td>5,905 (60)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>-51 (-88; -14)</td>
<td>0.006</td>
<td>4,159 (35)</td>
<td>-46 (-18; -10)</td>
<td>0.011</td>
<td>3,446 (35)</td>
</tr>
<tr>
<td>High</td>
<td>-137 (-212; -62)</td>
<td>&lt;0.001</td>
<td>685 (6)</td>
<td>-59 (-134; 15)</td>
<td>0.118</td>
<td>525 (5)</td>
</tr>
<tr>
<td>All pesticides</td>
<td>Ref.</td>
<td>11,369 (96)</td>
<td>Ref.</td>
<td>9,494 (96)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>-73 (-174; 29)</td>
<td>0.162</td>
<td>370 (3)</td>
<td>-115 (-214; -16)</td>
<td>0.023</td>
<td>303 (3)</td>
</tr>
<tr>
<td>High</td>
<td>-93 (-270; 83)</td>
<td>0.300</td>
<td>112 (0.9)</td>
<td>0 (-184; 184)</td>
<td>0.999</td>
<td>79 (0.8)</td>
</tr>
<tr>
<td>Herbicides</td>
<td>Ref.</td>
<td>11,680 (99)</td>
<td>Ref.</td>
<td>9,754 (99)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>-96 (-258; 65)</td>
<td>0.243</td>
<td>132 (1)</td>
<td>-105 (-267; 57)</td>
<td>0.204</td>
<td>101 (1)</td>
</tr>
<tr>
<td>High</td>
<td>-193 (-485; 99)</td>
<td>0.195</td>
<td>39 (0.3)</td>
<td>218 (-131; 567)</td>
<td>0.220</td>
<td>21 (0.2)</td>
</tr>
<tr>
<td>Insecticides</td>
<td>Ref.</td>
<td>11,425 (96)</td>
<td>Ref.</td>
<td>9,540 (97)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>-71 (-181; 39)</td>
<td>0.206</td>
<td>315 (3)</td>
<td>-114 (-221; -7)</td>
<td>0.036</td>
<td>258 (3)</td>
</tr>
<tr>
<td>High</td>
<td>-90 (-267; 87)</td>
<td>0.320</td>
<td>111 (0.9)</td>
<td>13 (-172; 198)</td>
<td>0.890</td>
<td>78 (0.8)</td>
</tr>
</tbody>
</table>

**Definition of abbreviation:** VGDF = the composite measure of vapors, gases, dusts, and fumes.

Statistically significant associations are depicted in bold (P values $< 0.05$).

*Occupational exposures (no/low/high) were estimated based on job title and function using the ALOHA+ job exposure matrix. Nonexposed subjects were assigned as reference category (Ref).

The linear regression model was adjusted for sex, age, height, weight, current smoking, former smoking, and (log) pack-years. The analyses on biological dust, mineral dust, gases and fumes, and the composite measure VGDF were additionally adjusted for pesticide exposure, whereas the analyses on pesticides, herbicides, and insecticides were additionally adjusted for exposure to the composite measure VGDF.

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**Figure 1.** Associations between occupational exposures and level of FEF$_{25-75}$ (ml/s) for subjects without large airways obstruction (FEV$_1$/FVC $\geq$ 70%, FEV$_1$ $\geq$ 80%), stratified by smoking status (never/ever). Associations are shown for no (reference: set on 0), low, and high exposure to the composite measure vapors, gases, dusts, and fumes (VGDF), and the subcategories biological dust, mineral dust, gases and fumes, pesticides in general, and the subcategories herbicides and insecticides.
and never-smokers (3). The lack of effects of smoking on small airways function in interaction with occupational exposure is in line with a previous study investigating biological dust (1).

Although exposure to pesticides was strongly and consistently associated with level of FEV₁ in our previous cross-sectional study (3), the trend for an association with FEF₂₅–₇₅ did not reach statistical significance and disappeared when analyses were restricted to subjects without large airways obstruction. In line with our findings, a study from Sri Lanka found no significant reduction in FEF₂₅–₇₅ levels of farmers exposed to pesticides, whereas there was a significant effect on FEV₁ and FVC levels (13). It may be that the aerodynamic diameter of the pesticide aerosols results in deposition mainly in the larger airways. A study assessing different types of pesticides and agricultural application methods showed that aerosols had a median aerodynamic diameter ranging from 4 to 16 μm (14), whereas for example fibrous dust has an aerodynamic diameter less than 3 μm and the majority of welding aerosols have an aerodynamic diameter less than 1 μm (15).

In conclusion, with the current study we show that occupational exposure to vapors, gases, dusts, and fumes induces small airways obstruction independently of large airways obstruction in both ever- and never-smokers. Loss and narrowing of the small airways is seen in patients with mild COPD even before the onset of emphysemaustion destruction, and becomes increasingly evident in severe COPD (4). Therefore, small airway obstruction should be taken into account when monitoring respiratory health of workers that are exposed to vapors, gases, dusts, and fumes.

References


Successful Management of a Chronic, Refractory Bronchopleural Fistula with Endobronchial Valves followed by Talc Pleurodesis

To the Editor:

Lymphangioleiomyomatosis (LAM) is a rare, neoplastic lung disease that affects women more often than men, and is associated with cystic destruction of the lung (1, 2). Over 65% of patients with LAM develop pneumothorax during the course of their illness, followed by two or more recurrences, on average (3, 4). An attempt at pleural symphysis with the first pneumothorax is therefore recommended, despite pleurodesis failure rates that exceed those of most other chronic lung diseases (3). The following case describes the use of one-way endobronchial valves to treat a persistent bronchopleural fistula that had failed to resolve after multiple prior medical and surgical management approaches.

The patient was a 39-year-old nonsmoking female physician who developed a spontaneous right pneumothorax. Computed tomography (CT) scanning of the chest revealed a large collection of air in the right anterior hemithorax, and numerous large round cysts varying in size from 3 mm to 4.6 cm (Figure 1A). Because of the unusual cyst dimensions, and an atypical basilar and peripheral distribution, the patient was initially thought to have Birt-Hogg-Dubé syndrome, but genetic testing for folliculin mutations was negative. Her pulmonary function tests were normal, and the pneumothorax was treated with simple chest tube drainage. She developed a recurrent right-sided pneumothorax 6 months later, treated initially for 2 days with small-bore chest tube drainage as an inpatient and continuing for 5 days after discharge with Heimlich valve-regulated drainage. She developed shortness of breath and decreased exercise tolerance 3 days after the chest tube was removed. She was found to have a right-sided pneumothorax and...