**Occupational Beryllium Exposure & High ILO Profusion Score Linked with Declining FVC**

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**Abstract:**

Background: Manufacturing nuclear weapons exposed workers to beryllium, asbestos, and other toxins. Beryllium causes lung fibrosis in sensitized individuals. Fibrosis is evaluated by X-ray (CXR), which is read with the International Labor Organization’s (ILO) Profusion Scale. Some question the ILO classifications’ clinical relevance. Hypothesis: 1) Increasing ILO scores correlate with decreased Forced Vital Capacity (FVC) independent of age, smoking status, and gender. 2) Beryllium exposure correlates with decreased FVC.

Methods: A cohort of 729 beryllium-exposed former nuclear weapons workers (FWs) recruited by mail, telephone, press releases, and word-of-mouth (n=729). Participants were recruited from 2001-2008 by mail, telephone, press releases, and word-of-mouth (n=729). Particpants were recruited from 2001-2008 by mail, telephone, press releases, and word-of-mouth (n=729). Particpants were recruited from 2001-2008 by mail, telephone, press releases, and word-of-mouth (n=729). Particpants were recruited from 2001-2008 by mail, telephone, press releases, and word-of-mouth (n=729). Particpants were recruited from 2001-2008 by mail, telephone, press releases, and word-of-mouth (n=729). Particpants were recruited from 2001-2008 by mail, telephone, press releases, and word-of-mouth (n=729). Particpants were recruited from 2001-2008 by mail, telephone, press releases, and word-of-mouth (n=729). Particpants were recruited from 2001-2008 by mail, telephone, press releases, and word-of-mouth (n=729). Particpants were recruited from 2001-2008 by mail, telephone, press releases, and word-of-mouth (n=729). Particpants were recruited from 2001-2008 by mail, telephone, press releases, and word-of-mouth (n=729).

Results: 

- No statistically significant association between smoking status (ever smokers vs. never smokers) and FVC % predicted (trend=2.659 (p=0.102, n=729)).
- In a linear regression of workers who reported Be exposure controlling for age, smoking status, and gender, we found increasing ILO scores significantly associated with decreasing FVC % predicted (Pearson partial correlation=-0.1768). There was no significant interaction between ILO scores and beryllium exposure. Correlation of ILO scores to FVC validates use of the ILO Scale for CXR evaluation. Exposure to beryllium and other metals was associated with lower FVC. The ILO Profusion Scale is an objective method to quantify lung damage.

Conclusion: Beryllium causes pulmonary fibrosis in sensitized individuals. The relationship of Be exposure to FVC % predicted demonstrates that the health of FWs is affected due to their occupational exposure to Be.

**Discussion & Conclusions:**

- Beryllium exposure is also associated with a decrease in FVC % predicted. In the long exposure of sensitized individuals, an immunological response occurs leading to pulmonary fibrosis.
- The association of ILO score to FVC % predicted is independent of gender, age, smoking status, and exposure. Both Be exposure and ILO are independently affecting the decrease in FVC % predicted.
- Accounting for beryllium exposure and ILO scale only improves the predictability of FVC % predicted by 5.43%. More research needs to be done on the genetic and other unaccounted for factors that influence the decrease in FVC % predicted in this former worker cohort.
- Overall, this validates the use of the ILO profusion scale to evaluate chest X-rays for epidemiological and clinical purposes.

**Introduction:**

From 1949-1975, Line 3 Division 8 manufactured nuclear weapons at the Iowa Army Ammunition Plant (IAAP) in Middletown, IA.

FWs were exposed to potentially harmful substances such as beryllium, solvents, biological agents, acids, and possible radiation. Beryllium causes an immunological response in susceptible individuals leading to pulmonary fibrosis.

In 1993, Congress passed a law requiring the Department of Energy to provide medical screenings for all former employees. The department chose to conduct these screenings at The University of Iowa.

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Three occupational medicine physicians read each CXR. They were blinded to each other’s readings, smoking status, and occupational category.

In ANOVA/ANCOVA model controlling for sex, ILO scale, smoking status, age, and beryllium exposure, both ILO groups 0-1 (Table 1) average FVC % predicted of 90.28% and groups 2-6 had average FVC % predicted of 75.64%; this difference was statistically significant. ANOVA/ANOVA analyses showed beryllium and ILO scores to both be independently associated with increased ILO scores had average FVC of 88.40% and abnormal ILO scores had average FVC of 73.64%.

**Table 1: Groups for FVC % Predicted**

<table>
<thead>
<tr>
<th>Group</th>
<th>Smoking Status</th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 0</td>
<td>0/0</td>
<td>458</td>
<td>26</td>
</tr>
<tr>
<td>Group 1</td>
<td>0/1</td>
<td>64</td>
<td>2</td>
</tr>
<tr>
<td>Group 2</td>
<td>1/0</td>
<td>55</td>
<td>1</td>
</tr>
<tr>
<td>Group 3</td>
<td>1/1</td>
<td>68</td>
<td>5</td>
</tr>
<tr>
<td>Group 4</td>
<td>1/2</td>
<td>22</td>
<td>4</td>
</tr>
<tr>
<td>Group 5</td>
<td>1/3</td>
<td>20</td>
<td>2</td>
</tr>
<tr>
<td>Group 6</td>
<td>3/3</td>
<td>11</td>
<td>1</td>
</tr>
</tbody>
</table>

**Results:**

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