Respiratory symptoms and lung function in young adults with severe alpha(1)-antitrypsin deficiency (PiZZ).

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Published in: Thorax

2002

Link to publication

Citation for published version (APA):
Background: Neonatal screening for alpha-antitrypsin (AAT) deficiency was undertaken in Sweden between 1972 and 1974 to study the pathophysiology and natural history of lung and liver disease in AAT deficiency. The cohort has been followed up prospectively. Methods: 124 PiZ subjects, still alive and still living in Sweden, were invited to a follow up examination at about 22 years of age. The check up included a clinical examination, spirometric tests, and a questionnaire on smoking habits and respiratory symptoms. Results: Ninety eight subjects (97 PiZZ and 1 PiZ−) subjects attended the follow up. The mean age of the subjects was 22.5 years (range 19.8–24.8). The mean (SD) forced expiratory volume in 1 second (FEV1) was 98 (14)% predicted, vital capacity (VC) was 103 (14)% predicted, and the mean FEV1/VC ratio was 83 (7)%. Eighty six subjects had previously undergone spirometric tests. The median follow up time was 4.3 years (range 0.9–7.3). The mean annual change in FEV1 (% predicted) was −1.2% (95% CI −2.1 to −0.3), in VC (% predicted) was −1.5% (95% CI −2.0 to −0.9), and in the FEV1/VC ratio (%) was −0.3% (95% CI −0.7 to 0.2). Twenty eight individuals (29%) reported recurrent wheezing. Fifteen subjects (15%) had been diagnosed by a physician as having asthma. Eighteen subjects reported that they had smoked at some time; 10 were current smokers. The mean number of pack years among the ever smokers was 3.4 (range 0.6–10.5). Ten of 18 ever-smokers and 18 of 80 non-smokers reported recurrent wheezing (p<0.01), while exertional dyspnoea was reported by six ever smokers and 11 non-smokers (p<0.05). Lung function test results did not differ significantly between ever smokers and non-smokers.

Conclusions: Young PiZ adults have essentially normal lung function, but have a high prevalence of asthma symptoms. Smoking in these individuals is associated with an increased frequency of respiratory symptoms.
performed in 71 subjects, six of whom (8%) had an increase of (range 74–142), and the mean FEV1/VC ratio was 83 (7)% predicted (range 52–131), mean VC was 103 (14)% predicted with (8%) reported both current phlegm and dyspnoea. (16%) and exertional dyspnoea by 17 (17%). Eight subjects circumstanes. Current phlegm was reported by 15 individuals strong odours, and six suffered from wheezing in other weather, 18 suffered from wheezing brought on by cold, five by Fourteen reported wheezing that was brought on by damp

### RESULTS

#### Lung function, respiratory symptoms, and diagnoses

Of 124 AAT-deficient individuals (122 PiZZ and two PiZ–), 52 men and 46 women participated in the study (97 PiZZ and one PiZ–). The mean age of the study participants was 22.5 years (range 19.8–24.8). The mean (SD) FEV1 was 98 (14)% predicted (range 63–99). A reversibility test with inhaled β2 agonists, two with inhaled corticosteroids, and eight subjects who did not attend the check up at 18 years of age, lung function was compared with the check up at 16 years.7

#### Statistical analysis

The Student’s t test was used to compare continuous variables between the groups. Two tailed paired t tests were used in the analysis of dependent variables. The χ2 test was used to compare categorical variables. p values of <0.05 were considered significant.

### Table 1

<table>
<thead>
<tr>
<th></th>
<th>Non-smokers</th>
<th>Ever-smokers</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Current phlegm</strong></td>
<td>11/78</td>
<td>4/18</td>
</tr>
<tr>
<td></td>
<td>14%</td>
<td>22%</td>
</tr>
<tr>
<td><strong>Recurrent wheezing</strong></td>
<td>18/80</td>
<td>10/18</td>
</tr>
<tr>
<td></td>
<td>23%</td>
<td>56%†</td>
</tr>
<tr>
<td><strong>Exertional dyspnoea</strong></td>
<td>11/80</td>
<td>6/18</td>
</tr>
<tr>
<td></td>
<td>14%</td>
<td>33%*</td>
</tr>
</tbody>
</table>

*p<0.05; †p<0.01 (χ2 test).

### Table 2

#### Mean age and lung function in 80 non-smokers and 18 ever smokers (ex-smokers and current smokers) at the 22 year check up

<table>
<thead>
<tr>
<th></th>
<th>Non-smokers</th>
<th>Ever-smokers</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FEV1 (% pred)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>99</td>
<td>95</td>
</tr>
<tr>
<td>95% CI</td>
<td>96–102</td>
<td>88–102</td>
</tr>
<tr>
<td>VC (% pred)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>104</td>
<td>103</td>
</tr>
<tr>
<td>95% CI</td>
<td>100–107</td>
<td>96–110</td>
</tr>
<tr>
<td><strong>FEV1/VC (%)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>84</td>
<td>82</td>
</tr>
<tr>
<td>95% CI</td>
<td>82–85</td>
<td>78–85</td>
</tr>
</tbody>
</table>

FEV1=forced expiratory volume in 1 second; VC=vital capacity.

#### Respiratory symptoms and lung function in relation to smoking habits

Ten subjects (three men) were current smokers. Two men and six women reported that they had stopped smoking. Among the ever smokers—that is, ex-smokers and current smokers—the mean number of pack years was 3.4 (range 0.6–10.5). The prevalences of self-reported recurrent wheezing (p<0.01) and exertional dyspnoea (p<0.05) were significantly higher in the ever smokers than in the non-smokers (table 1). Three of 18 ever smokers (17%) and five of 78 non-smokers (6%) reported both current phlegm and exertional dyspnoea. No significant differences in lung function were found between ever smokers and non-smokers (table 2), or between current smokers and non-smokers (data not shown).

#### Longitudinal analysis of lung function

Eighty-six of the 98 participants (46 men) had performed lung function tests previously: 74 subjects at the 18 years check up and 12 subjects at the 16 years check up. The mean age of the subjects at time of the first spirometric test was 18.1 years (range 16.0–19.8). The median follow up time was 4.3 years (range 0.9–7.3). The results of the lung function tests at both check ups are shown in table 3. The changes in FEV1 and VC, expressed as % predicted values, showed a significant annual decline. Fifteen of the 86 subjects reported having smoked at some time, and nine were current smokers at the present check up. The mean annual change in FEV1, VC, and FEV1/VC ratio did not differ significantly between ever smokers and non-smokers.

#### Subjects not participating in the present follow up examination (“drop outs”)

Of the 124 PiZ individuals who had been invited to the present follow up, 26 did not attend the clinical examination or spirometric test. Fourteen had attended a previous check up at 16 or 18 years of age and reported that they had never smoked. No information was available on smoking habits or health status of the remaining 13 subjects who had not attended the previous check ups at 16 or 18 years of age.

### DISCUSSION

This study was included in the long term follow up of the PiZ individuals identified by the Swedish neonatal AAT screening study during 1972–4. Our results indicate that lung function is still essentially normal in 20–24 year old individuals with severe AAT deficiency (PiZZ). However, all lung function test results, when expressed as a percentage of reference values, were significantly lower than at the previous check up at 16 or 18 years of age (table 3). We compared spirometric results with reference values published by Knudson and coworkers,12 which we also used in our previous analysis of lung function in the cohort.13 Using the same reference values in both studies made possible a longitudinal analysis of lung function expressed as percentage predicted values. Overall changes in lung function were small, which may indicate that lung function in these subjects had reached a plateau phase during the observation period.14
In contrast to the results of our previous analysis of risk factors for lung disease in AAT-deficient adolescents,\textsuperscript{11} we did not find significant differences in lung function between smokers and non-smokers (table 2). The significantly increased prevalence of self-reported respiratory symptoms in the smoking subjects indicates, however, that harmful effects of smoking are already in progress (table 1). We found similar results at the previous check up at the age of 16–18 years when the presence of current phlegm was more common among ever smokers than non-smokers.\textsuperscript{11} All data on smoking history were self-reported by the study participants, and no objective tests were performed to verify their smoking status.

At the 16 year check up the prevalence of self-reported recurrent wheezing among 103 PiZZ individuals was 10.7%.\textsuperscript{7} At the present examination 29% of the individuals reported recurrent wheezing, while 15% had physician reported asthma. Previously published reports have suggested that symptoms and diagnosis of asthma are over-represented in severe AAT deficiency.\textsuperscript{\textsuperscript{15}} The prevalence of asthma reported in the Swedish general population varies from 5% to 11%.\textsuperscript{16} Taking into account the high prevalence of self-reported recurrent wheezing in our study, it may support an over-representation of asthmatic symptoms in severe AAT deficiency. It is therefore possible that respiratory symptoms are initially interpreted as “usual” asthma when young PiZZ adults seek health care, which may delay the correct diagnosis. This is especially critical for young PiZZ smokers who may develop irreversible obstructive pulmonary disease within a few years if they continue smoking. Our results may support the WHO recommendation that all adults and adolescents with asthma should be screened for AAT deficiency.\textsuperscript{\textsuperscript{17}} Moreover, a postal survey of AAT-deficient individuals in the USA has shown that the mean delay between the first symptoms and the correct diagnosis of AAT deficiency was 7.2 years, indicating that the symptoms may be misunderstood by doctors.\textsuperscript{18}

In contrast to other epidemiological studies on AAT deficiency, our study was not affected by selection bias because the study population represented 79% of all PIZZ individuals born in Sweden between 1972 and 1974. Although this is the largest ongoing epidemiological study of AAT deficiency, the number of subjects in subgroups such as smokers is low as a result of effective smoking prevention. The power to detect significant differences between the groups is therefore low and false negative results cannot be excluded. Our results may also have been influenced by the lack of an age and sex matched control group. The follow up of a parallel healthy cohort has not been practically possible because the participants in the study are spread throughout Sweden. We therefore compared the smoking habits of the study participants with the statistics published by Statistics Sweden. In our study three of 52 men (6%) and seven of 46 women (15%) reported that they were current smokers. According to Statistics Sweden, the proportion of daily smokers was about 12% among men and 20% among women aged 16–24 years in Sweden during the same period as the present study was being performed.\textsuperscript{19}

We conclude that young PIZZ adults have essentially normal lung function. The prevalence of asthmatic symptoms seems to be high, and smoking is associated with an increased frequency of respiratory symptoms.

**ACKNOWLEDGEMENTS**

This study was supported by grants from the Swedish Heart Lung Foundation. The authors wish to thank Lena Rubin for the administrative assistance and all the Swedish physicians who made this study possible by reporting data to the investigators.

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Support: Swedish Heart Lung Foundation.

**REFERENCES**