Pulmonary Functions in Trained and Untrained Wind Instrument Blowers

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Abstract:
The present cross-sectional study was designed to ascertain whether regular and trained wind instrument blowers develop higher pulmonary functions than untrained or part time blowers.

The study included 155 trained & regular blowers (Group A), 100 untrained part-time blowers (Group B) and 100 non-blowers (Group C). They were investigated by a computerized spirometer (RMS medspiror).

Group A subjects showed a significantly higher \( (p<0.001) \) percentage predicted value for Forced Vital capacity (FVC), Forced expiratory volume in the 1st second (FEV\(_1\)), Peak Expiratory Flow Rate (PEFR), Maximum Voluntary Ventilation (MVV), Forced Expiratory Flow at 25\% & 50\% of FVC (FEF25\% & FEF50\%), Forced Expiratory Flow between 25\% & 75\% of FVC (FEF 25-75\%), FEF50\% of FVC, than the other two groups. However, FEV\(_1\)/FVC \% in group A was not statistically higher than the other two groups \( (p=0.3699) \). Thus, regular training of wind instrument blowing increases the pulmonary functions which may be a physiological advantage of blowing.

Key Words: Wind Instrument, Pulmonary function test, Physiological effects.

Introduction:
Few studies conducted on wind instrumentalists have concluded that the wind instrument blowers have higher pulmonary functions (PFT) due to increased respiratory muscle strength, most probably the consequence of regular ventilatory muscle training (Fiz et al, 1993; Munn et al, 1990).

The study conducted by Bouhuy (1964) revealed higher vital capacity in brass players than the non-blowers. Barbenel et al (1988) showed that mouth pressure got increased with the increase in loudness in trumpet blowers as compared with the non-blowers. In similar study in trumpeters, Fiz et al (1993) found higher maximum inspiratory pressure (PImax) and maximum expiratory pressure (PEmax). Kahane et al (2006), concluded that the bassoon players had higher subglottic pressure during prolonged expiratory blowing activity. Cossette (2002) and Cossette et al (2008) showed that flute blowers developed higher mouth pressure during high intensity blowing and also observed that flautists used 72-83\% of their vital capacity during flute blowing. Schorr-Lesnick et al (1985) found higher percentage predicted FVC in singers than the non-blowers i.e. string and percussion instrumentalists.

The study conducted in similar occupation i.e. glassblowers showed a significant increased forced vital capacity (FVC), forced expiratory volume in 1\(^{st}\) second of FVC (FEV\(_{1}\)) and the maximum flow rates at 25\% and 50\% of FVC (FEF25\% and FEF50\%) as compared to non-blower controls. In all of the above studies, blowers were compared with the non-blowers, but there were no comparison between the trained and untrained blowers.

The present study was conducted to determine the effect of blowing the wind instrument by trained, untrained and non blowers on PFT.

Material and Methods:
The present cross sectional study included 355 male non-smoker normal subjects of age ranging between 20 to 50 years; out of which 155 were regular trained blowers currently employed in a performing role (Group A), 100 untrained part-time blowers who performed blowing only on occasions (Group B) and 100 non-blowers (Group C).

After obtaining the approval from the institutional ethical committee, we conducted the study at military music training center, Pachmarhi (M.P), various local band party centers at Nagpur & N.K.P Salve Medical College & Hospital, Nagpur (Maharastra).

Smokers and those suffering from any prevailing illness were excluded from the study. For purpose of study, a smoker was defined as a regular cigarette, cigar, bidi or pipe smoker up to a month prior
to testing while a non-smoker was either an ex-smoker (ceased smoking for more than a month ago) or had smoked less than 1 cigarette or bidi per day in one year or 1 cigar per week in one year (Blackburn et al, 1959). Prevailing illness included any recent viral infection (within 2-3 weeks) or other acute illness (especially that involved the respiratory tract) and a serious illness such as recent myocardial infarction, pulmonary emboli, moderate to severe ascitis (Ferris, 1978).

The pulmonary function tests were performed by Medspiror, an automated, computerized flow sensing turbine type of Spirometer with an internal correction of volume with body temperature and pressure saturated (BTPS). All the subjects were made familiar with the procedure. The baseline data that is name, age, height, weight, body mass index, years of blowing, date of performing the test and atmospheric temperature was fed to the computerized medspiror. The test was performed in sitting position (Pierson et al, 1976). The parameters like FVC: Forced vital capacity, FEV1: Forced expiratory volume in 1 second, FEV1/FVC %: ratio of FEV1/FVC in %, FEF-25%: Forced expiratory flow of 25% of FVC, FEF-50%: Forced expiratory flow of 25% of FVC, FEF-75%: Forced expiratory flow of 75% of FVC, FEF25-75%: Forced expiratory flow between 25% & 75% of FVC, PEFR: Peak Expiratory flow rate, MVV: Maximum voluntary ventilation were recorded three times & the best of the three was noted. The percentage predicted values rather than the actual values were used for analyzing the data. The data was analyzed by using ANOVA one way for all the parameters except ‘period of blowing’ where unpaired t test was applied.

Results:

Out of 355 enrolled subjects, there were 255 trained and untrained blowers put together. Out of 255 blowers, 58 were trumpet blowers, 56 clarinet blowers, 36 euphonium blowers, 30 bag pipers, 23 cornet blowers, 17 saxophone blowers, 11 trombone blowers, 8 bugle blowers, 4 flutist, 3 each were French-horn blowers oboe blowers and bass blowers; 2 were sousaphone blowers and 1 was bassoon blower.

Age wise distribution of subjects is depicted in Table I. When overall age distribution in three groups was analyzed, it was observed that the mean age of Group B (35.5 yrs) was more than Group A (33.16 yrs.) and Group C (33.65 yrs). However, it was not statistically significant (p=0.0536). Basal metabolic index (BMI) was comparable in the three groups and the difference was not statically significant (p=0.3916). The mean period of blowing in years was more in Group B (14.08 yrs) than Group A (12.23 yrs), but the difference was not significant (p=0.0552; Table II).

Table I: Age distribution of subjects in all the 3 groups.

<table>
<thead>
<tr>
<th>Age in Years</th>
<th>Group A (n = 155)</th>
<th>Group B (n = 100)</th>
<th>Group C (n = 100)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 – 30</td>
<td>61 (39)</td>
<td>32 (32%)</td>
<td>38 (38%)</td>
</tr>
<tr>
<td>31 – 40</td>
<td>62 (40%)</td>
<td>43 (43%)</td>
<td>40 (40%)</td>
</tr>
<tr>
<td>41 – 50</td>
<td>32 (21%)</td>
<td>25 (25%)</td>
<td>22 (22%)</td>
</tr>
</tbody>
</table>

Table II: Mean age, BMI and period of blowing in various groups.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Group A (n = 155)</th>
<th>Group B (n = 100)</th>
<th>Group C (n = 100)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>33.16 ± 6.77</td>
<td>35.5 ± 7.74</td>
<td>33.65 ± 8.14</td>
<td>p=0.0536</td>
</tr>
<tr>
<td>BMI</td>
<td>22.63 ± 2.17</td>
<td>22.44 ± 2.82</td>
<td>22.21 ± 2.18</td>
<td>p=0.3916</td>
</tr>
<tr>
<td>Period of blowing in years</td>
<td>12.23 ± 7.23</td>
<td>14.08 ± 7.78</td>
<td>-</td>
<td>p=0.0552</td>
</tr>
</tbody>
</table>

The mean predicted value of FVC, FEF25-75%, PEFR, FEF 50%, FEF 75% and MVV was significantly higher (p<0.001) in regular trained wind instrument blowers (Group A) than in Group B & C. However, when FEV1/ FVC% and FEF 25%, were considered no statistical difference was found in regular trained blowers and untrained non blowers (Table III).

Discussion:

The voluntary breath control is essential for playing wind instruments and the wind instrumentalists undergo continuous ventilatory muscle training (Fiz et al, 1993; Schorr-Lesnick et al, 1985). Training of ventilatory muscles follows the basic principle of training any striated muscle with regards to specificity, intensity and duration of training (Kisner & Colby, 2007; Kreuter et al, 2008, Wang et al, 2002).

Our findings of higher FVC and FEV1 values and slightly reduced FEV1/FVC value in trained blowers were supported by the study conducted by Schorr-Lesnick et al (1985) on brass wind instrument players where the percentage predicted FVC value (98.7 ± 13.1) and FEV1(103.5 ± 15.5) were higher in the blowers than the non-blowers (FVC=97.2 ± 13.8
and FEV1=101.9 ± 17.6). Similarly in the blowers, the percentage predicted FEV1/FVC (78.0 ± 6.8) value was slightly less than the non-blowers FEV1/FVC (79.1 ± 9.4). Likewise, in the blowers percentage predicted MVV (118.2 ± 22.2) was higher than the non-blowers MVV (112.5 ± 25.2).

The studies conducted in a similar occupation i.e. glass blowers, by Munn et al (1990) and Navratil & Rejsek (1968) also supported our results of FVC, FEV1 & FEV1/FVC. In their study, the percentage predicted FVC and FEV1 were significantly more in full time glass blowers than part time blowers, and non-glass blowers.

Munn et al (1990) also showed higher percentage predicted mid expiratory flow (MEF), FEF 25-75% and MVV than part-time blowers and the non-blowers.

According to the hypothesis given by Schorr-Lesnick et al (1985), the musicians have exceptional pulmonary functions, a physiological advantage due to the respiratory muscle training. We also found higher pulmonary functions in our trained blowers. An explanation for higher FVC values in our trained wind instrument blowers might be due to their regular breathing pattern of using the whole vital capacity skillfully during the play with deep inspiration followed by prolonged expiration through the instrument. The greater FEV1, FEF25-75%, FEF25 %, 50% & 75% and PEFR might be due to higher FVC in trained blowers. The low value of FEV1/FVC in trained blowers than the other two groups might probably be due to greater FVC. The greater MVV in trained blowers could be due to the increased respiratory muscle strength, probably the result of regular ventilatory muscle training (Bouhuys, 1964; Munn et al, 1990; Fiz et al, 1993; Fletcher, 2000; Kreuter et al, 2008).

Other factors that were thought to influence the results included the motivation of the trained blowers and their regular physical (military) training. It would seem that our trained blowers may be motivated more by the traditionally adapted blowing maneuvers in military, related to an ability which the trained military blowers played in high regards. The physical military training in addition, might also cause strengthening of the respiratory muscles (Huang & Li, 1993).

It could be concluded that the trained wind instrument blowers had higher pulmonary functions than the untrained blowers and the non-blowers, which might be a physiological advantage due to regular training of blowing. The untrained blowers if blow regularly, can adapt proper blowing techniques.

**Bibliograph:**


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**Conflict of Interest**: None declared.