INTRODUCTION

Previous studies on pulmonary function have concluded that ventilatory efficiency as well as peak oxygen uptake is dependant upon age, sex, race, gender, body size, and height (Huedenberg et al. 1998).

Some researchers have suggested that pulmonary function may vary by time of day, but other studies show little or no effect. Burioka et al. (1999) examined 13 healthy men (31.5 ±4.3 years), without any cardiopulmonary disease and determined that lung diffusing capacity for carbon monoxide did not exhibit a circadian rhythm, but that alveolar volume peaked in the morning hours. Other investigators showed that the peak expiratory flow did follow a circadian rhythm with the highest values being observed late afternoon, and lowest values at night or early morning (van Aalderen et al. 1993, Jindal et al. 2002). Calhoun (2003) stated that lung function in a healthy individual varied in a circadian rhythm, with peak lung function occurring near the 1600 hour and minimal lung function at the 0400 hour.

A study conducted by Aguilar et al. (1996) reported that there was no significant daytime variance in maximum inspiratory and expiratory pressures, values which measure the maximum respiratory muscle force developed by all respiratory muscles.

Jindal et al. (2002) suggested that diurnal variability in peak expiratory flow (PEF) was more exaggerated in patients with asthma. A study on the pathophysiology of asthma conducted by Silkoff and Martin (1998) concluded experiencing asthma attacks showed a pronounced circadian variation with the majority of patients experiencing increased symptoms at night. Calhoun (2003) described an episode of nocturnal asthma as an exaggeration in normal variation in lung function from daytime to nighttime, with diurnal changes in pulmonary function of >15%. Jindal et al. (2002) suggested that diurnal variability of PEF was perhaps one of the most important causes of concern for a clinician.

The purpose of this investigation was to determine if pulmonary ventilation in college age subjects exhibited a circadian rhythm.

RESULTS

The coefficient of variation of the spirometer used in this study was 2.3%. Significant differences (p<0.001) were observed between male and female forced vital capacities (fig.1).

![Figure 1: The mean forced vital capacity (FVC) for males and females tested during morning and afternoon hours. * = p < 0.001](image)

Figure 2 shows the mean forced vital capacity of all subjects tested. There were no significant differences in forced vital capacity observed within subjects tested in the morning and afternoon (Table 1).

![Figure 2: The forced vital capacity of all subjects in the morning and in the afternoon.](image)

<table>
<thead>
<tr>
<th>Subjects Combined</th>
<th>Morning (cc)</th>
<th>Afternoon (cc)</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>FVC (cc)</td>
<td>3528.49 (±831.04)</td>
<td>3494.09 (±847.63)</td>
<td>0.5007</td>
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<tr>
<td>Females</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FVC (cc)</td>
<td>2957.78 (±762.41)</td>
<td>2999.99 (±753.61)</td>
<td>0.5124</td>
</tr>
<tr>
<td>Males</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FVC (cc)</td>
<td>2523.96 (±557.57)</td>
<td>3966.88 (±580.66)</td>
<td>0.7399</td>
</tr>
</tbody>
</table>

CONCLUSIONS

The significant differences found between the forced vital capacities of males and females, indicate gender differences with respect to the ability to force air out of the lungs. These differences are primarily due to size of the thoracic cavity and strength of the intercostal muscles.

These data indicate forced vital capacity does not follow a circadian rhythm in healthy college age persons, therefore the results are consistent with the findings of Aguilar et al. (1996) who observed no significant daytime variance in maximum expiratory and inspiratory pressures. Although there were differences individually among subjects, this variation was inconsistent and not significant. This study differs from those of Burioka et al. (1999) and van Aalderen et al. (1993) by focusing on vital capacity a pulmonary value more related to total air movement than peak expiratory flow which measures only exhalation.

The study of Calhoun (2003) emphasized the importance of considering patterns of ventilatory efficiency in diagnosing respiratory problems. This study determined vital capacity of normal individuals did not differ significantly; therefore large variations in pulmonary function may occur diurnally. Although the focus of this study was not to evaluate lung capacity changes in individuals with pulmonary disease, the results contribute to the potential of using daily fluctuations in vital capacity to gauge lung dysfunction.

LITERATURE CITED


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