Inhomogeneous gas mixing, a component of obstructive lung disease, results in increased anatomical deadspace. This may be reflected by disparity between alveolar volume (VA) and total lung capacity (TLC), thus reducing the VA/TLC%. However, there is limited research evaluating the significance of the VA/TLC%, particularly defining the lower limit of normal (LLN) and the degree to which it corresponds to the forced expiratory volume in one second (FEV$_1$) as a ratio of the vital capacity (VCmax).

**Method:** Pulmonary function tests of non-restrictive patients performed between 20/4/2012 and 5/12/2013 were allocated to two groups. Group 1 included subjects with FEV$_1$/VCmax$>0.7$ (n=369) and group 2 with FEV$_1$/VCmax$<0.7$ (n=549).

The VA was measured by methane dilution during single breath gas transfer and TLC measured by multi-breath helium dilution. The VA/TLC% was presented as mean ($\bar{x}$) (standard deviation $[\sigma]$). Linear regression analysis and Pearson’s correlation coefficient was presented as the correlation coefficient ($r$), regression equation and the level of significance. Independent t-tests were performed to find significant differences between variables. The LLN for VA/TLC% was given as $\bar{x}-(1.645*\sigma)$ for the sample of normal individuals. A level of significance was set at $p<0.05$.

<table>
<thead>
<tr>
<th>Group</th>
<th>VA/TLC% $\bar{x} (\sigma)$</th>
<th>VA/TLC% LLN</th>
<th>Significance</th>
<th>Linear regression analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>89.82 (4.51)</td>
<td>82.40</td>
<td>t(367)=6.55, p=0.00</td>
<td>TLC=0.415+(1.028*VA) $r=0.975, p=0.00$</td>
</tr>
<tr>
<td>Group 2</td>
<td>83.73 (7.50)</td>
<td>71.39</td>
<td>t(547)=8.32, p=0.00</td>
<td>TLC=1.029+(0.978*VA) $r=0.927, p=0.00$</td>
</tr>
</tbody>
</table>

**Table 1- Summary of results**

**Results:**

The mean difference between VA and TLC in group 1 was statistically significant [$t(367)=6.55, p=0.00$] meaning that VA cannot replace TLC even when the estimated anatomical deadspace is included [$t(367)=4.71, p=0.00$]. However the correlation is sufficient between VA and TLC ($r=0.975$) to use the regression equation to reliably predict TLC from VA.

The difference between VA and TLC in group 2 was statistically significant ($t=8.32, p=0.00$). The VA correlated with TLC ($r=0.927$) giving the regression equation in table 1.

Linear regression analysis identified a significant moderate correlation between VA/TLC and FEV$_1$ percentage of predicted ($r=0.619, p=0.00$), FEV$_1$/VCmax ($r=0.616, p=0.00$) and RV/TLC ($r=0.694, p=0.00$).

**Conclusion:**

The normal value for VA/TLC% is yet to be established; however this study gives a LLN of 82.4%, which corresponds to 82.8% in the study by Roberts, MacRae & Seed (1990) [1]. Whilst the regression equation for group 1 is applicable to a normal population, the regression equation for group 2 cannot encompass the breadth of airflow obstruction severity. To generate accurate regression equations in obstructive patients, given the complexity associated with increasing airflow severity and inhomogeneous gas mixing, further analysis is required.
It was anticipated FEV1/VCmax would be an independent predictor for the VA/TLC% because they are both influenced by airway calibre. However the moderate correlation between these variables suggests their values are not independently analogous.

Reference: