Exploring the currency of spirometric predictive equations from the viewpoint of the Lung Age concept.

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Abstract

Spirometry is used to diagnose respiratory disease, to monitor disease progression and response to treatment, and in epidemiological surveys. As a large burden of disease is caused by cigarette smoking, spirometry has been incorporated in smoking cessation counselling in an attempt to improve quit rates. The concept of lung age (LA) was developed in 1985 in an effort to make spirometry results more easily understood by the lay person. Research results using LA to aid quitting remain inconclusive. This thesis investigates the need to update LA equations, as predictive equations based on old data may not be relevant for today’s populations, and contemporary equations may result in a stronger message for smokers.

New LA equations were firstly developed using contemporary Australian data and four further LA equations were derived from previously published FEV₁ predictive equations. A series of comparisons of LA equations in contemporary Australian datasets followed.

The first project compared the original Morris LA equations with newly developed Australian LA equations in an independent workplace dataset (males only).

The second project compared four extra LA equations derived from previously published FEV₁ equations from Europe, the United Kingdom, America and Australia with the Morris and the new Australian equations. An independent dataset of randomly-selected males and females was used to compare these equations with the Morris LA equations and contemporary Australian LA equations.
Lastly, a different type of LA equation expressed as delta lung age (ΔLA), the difference between chronological age and lung age, based on the ratio of Forced Expiratory Volume in one second/Forced Vital Capacity (FEV$_1$/FVC), was compared with three other LA equations based on FEV$_1$ alone. This project used three independent datasets (urban, rural and a workplace) for added strength.

All LA equations confirmed poorer lung function in smokers than in never smokers in all 3 independent datasets. LA estimates were approximately 20 years lower using the original Morris equations when compared with the newest LA equations. The differences seen between estimated LA using all six equations were consistent in each analysis. The ΔLA equation gave extreme LA estimates in both the community-based datasets compared with the LA equations based on FEV$_1$ alone.

These results show that the Morris LA equations need to be updated. However, there appears to be no advantage in using the ΔLA equation. The differences between the older and the newer LA equations are most likely a result of cohort and period effects. This is also the case in the predictive equations themselves. Continuously updating predictive equations using recently acquired data will result in LA equations that are more relevant to contemporary populations.
Declaration

I certify that this work contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text. In addition, I certify that no part of this work will, in the future, be used in a submission for any other degree or diploma in any university or other tertiary institution without the prior approval of the University of Adelaide and where applicable, any partner institution responsible for the joint-award of this degree.

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Wendy Newbury (candidate)
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## Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Form</th>
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<tbody>
<tr>
<td>ATS</td>
<td>American Thoracic Society</td>
</tr>
<tr>
<td>COPD</td>
<td>Chronic Obstructive Pulmonary Disease</td>
</tr>
<tr>
<td>CS</td>
<td>Current Smokers</td>
</tr>
<tr>
<td>ECSC</td>
<td>European Community for Steel and Coal</td>
</tr>
<tr>
<td>ERS</td>
<td>European Respiratory Society</td>
</tr>
<tr>
<td>FEF&lt;sub&gt;50&lt;/sub&gt;</td>
<td>Forced Expiratory Flow at 50%</td>
</tr>
<tr>
<td>FEV&lt;sub&gt;1&lt;/sub&gt;</td>
<td>Forced expiratory volume in first second</td>
</tr>
<tr>
<td>FEV&lt;sub&gt;1&lt;/sub&gt;/FVC</td>
<td>ratio of FEV&lt;sub&gt;1&lt;/sub&gt; to FVC</td>
</tr>
<tr>
<td>FVC</td>
<td>Forced Vital Capacity</td>
</tr>
<tr>
<td>IOS</td>
<td>Impulse Oscillometry System</td>
</tr>
<tr>
<td>LA</td>
<td>Lung Age</td>
</tr>
<tr>
<td>∆LA</td>
<td>Delta Lung Age (Difference between LA and chronological age)</td>
</tr>
<tr>
<td>LLN</td>
<td>Lower Limit of Normal</td>
</tr>
<tr>
<td>MFS</td>
<td>Metropolitan Fire Service</td>
</tr>
<tr>
<td>NHANES III</td>
<td>Third National Health and Nutrition Examination Survey</td>
</tr>
<tr>
<td>NWAHS</td>
<td>North West Adelaide Health Study</td>
</tr>
<tr>
<td>PEF</td>
<td>Peak Expiratory Flow</td>
</tr>
<tr>
<td>RCT</td>
<td>Randomised Controlled Trial</td>
</tr>
<tr>
<td>SA</td>
<td>South Australia</td>
</tr>
<tr>
<td>SDL-age</td>
<td>Spirometry Derived Lung Age</td>
</tr>
<tr>
<td>UK</td>
<td>United Kingdom</td>
</tr>
<tr>
<td>ULN</td>
<td>Upper Limit of Normal</td>
</tr>
<tr>
<td>USA</td>
<td>United States of America</td>
</tr>
<tr>
<td>WISH</td>
<td>Whyalla Intergenerational Study of Health</td>
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