SUPPLEMENTARY MATERIAL

REFERENCES OF EXCLUDED STUDIES

Studies without control group


S30. Raju S. A study of lung function test in type 1 diabetes mellitus and type 2 diabetes mellitus. Raju Ghandi University of Health Sciences, Bangalore, India. These 2013.


Studies that included patients with mixed type 1 and type 2 diabetes mellitus


Studies reporting insufficient data for inclusion in the meta-analysis


S124. Pillai SB. Evaluation of clinicoradiological pulmonary manifestations in type 2 diabetes mellitus and correlation between pulmonary function test and glycemic control. Medical University Tamilnadu, Chennai, India. These, 2013.


S133. El-Jundi H, Dagdelen S, Demir AU, El-Jundi O, Çöplü L. Insulin therapy preserves pulmonary diffusing capacity. ERS 2017; [abstract]


Studies with duplicate or overlapping data


S145. Thangadhurai A. Assessment of pulmonary function tests in type 2 DM (spirometry based. The Tamilnadu Medical University. Chennai, India. These, 2012.


Predatory journals


S168. Bhuvaneswari T. Diabetes mellitus alters the pulmonary function test parameters among the patients attending regular check-up in tertiary care hospital in and around Chennai - Evidence-based study. Int Arch Integr Med 2017; 4: 1-5.


Grey literature

11


S183. Bhavya RL. Pulmonary functions in type 2 diabetic patients and its correlation with factors affecting glycemic status. The Tamilnadu Dr. M. G. R Medical University. Chennai, India These, 2017.

Other


### Table S1A. Meta-regression with subgroup analysis

<table>
<thead>
<tr>
<th>Continent</th>
<th>BMI (kg/m²)</th>
<th>Male</th>
<th>Female</th>
<th>Nonsmokers</th>
<th>Male</th>
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### Table S1B. Meta-regression with subgroup analysis

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Abbreviations: BMI, body mass index; DLCO, diffusion capacity of the lung for carbon monoxide; FEV\textsubscript{25-75%}, forced expiratory flow between 25% and 75% of total lung capacity; FEV\textsubscript{1}, forced expiratory volume in one second; FVC, forced vital capacity; NA, not applicable; PEF, peak expiratory flow.
<table>
<thead>
<tr>
<th>Table S2A. Sensitivity analysis</th>
<th>FEV₁ (L)</th>
<th>FVC (L)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Studies</td>
<td>Participants</td>
</tr>
<tr>
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<td></td>
<td></td>
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<td>940</td>
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<td>23,495</td>
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<td>20,774</td>
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<table>
<thead>
<tr>
<th>Table S2B. Sensitivity analysis</th>
<th>FEF₂₅-₇₅ (L)</th>
<th>PEF (L/s)</th>
<th>DlCO (cm H₂O/L/min/mmHg)</th>
</tr>
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<td>Studies</td>
<td>Participants</td>
<td>Effect estimate</td>
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<td>Statistical analysis method</td>
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<td>Random effect</td>
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<td>825</td>
<td>-0.48 (-0.71, -0.24)</td>
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<td>-0.47 (-0.54, -0.39)</td>
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<tr>
<td>Publication year</td>
<td></td>
<td></td>
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<td>Before 2000</td>
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<td>NA</td>
<td>NA</td>
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<td>2000-2009</td>
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<td>288</td>
<td>-0.35 (-0.53, -0.17)</td>
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<td>2010-2019</td>
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<td>537</td>
<td>-0.54 (-0.92, -0.16)</td>
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<tr>
<td>Type-2 diabetes group size</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>&lt;50 patients</td>
<td>9</td>
<td>535</td>
<td>-0.57 (-0.85, -0.29)</td>
</tr>
<tr>
<td>≥50 patients</td>
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<td>Study quality</td>
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<tr>
<td>Only good quality studies</td>
<td>12</td>
<td>825</td>
<td>-0.48 (-0.71, -0.24)</td>
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<tr>
<td>Including predatory journals and grey literature</td>
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<td>2027</td>
<td>-1.08 (-1.41, -0.74)</td>
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<tr>
<td>Excluding the greatest weight study</td>
<td>11</td>
<td>753</td>
<td>-0.49 (0.79, -0.20)</td>
</tr>
</tbody>
</table>

Abbreviations: DlCO, diffusion capacity of the lung for carbon monoxide; FEV₁, forced expiratory volume in one second; FVC, forced vital capacity; NA, not applicable; PEF, peak expiratory flow.
Figure S1. Forest plot of forced expiratory volume in one second (L)

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Type-2 Diabetes Mean</th>
<th>Type-2 Diabetes SD</th>
<th>Type-2 Diabetes Total</th>
<th>Control Mean</th>
<th>Control SD</th>
<th>Control Total</th>
<th>Mean Difference IV, Random, 95% CI</th>
<th>Mean Difference IV, Random, 95% CI</th>
</tr>
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<tbody>
<tr>
<td>Akel et al., 2013</td>
<td>1.7</td>
<td>0.1</td>
<td>30</td>
<td>2.89</td>
<td>0.95</td>
<td>40</td>
<td>3.7% -1.19 (1.38, 1.98)</td>
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<tr>
<td>Apana, 2014</td>
<td>2.045</td>
<td>0.45</td>
<td>50</td>
<td>2.98</td>
<td>0.41</td>
<td>15</td>
<td>20.6% -0.94 (1.31, 1.37)</td>
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<tr>
<td>Adero, 2013</td>
<td>2.8</td>
<td>0.33</td>
<td>63</td>
<td>2.95</td>
<td>0.14</td>
<td>78</td>
<td>29.3% -6.35 (4.44, 9.26)</td>
<td></td>
</tr>
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<td>Al-Awadi, 2013</td>
<td>2.7</td>
<td>0.5</td>
<td>60</td>
<td>2.96</td>
<td>0.94</td>
<td>57</td>
<td>2.5% -0.16 (0.36, 0.66)</td>
<td></td>
</tr>
<tr>
<td>Arandhubaksh et al., 2013</td>
<td>1.9</td>
<td>0.6</td>
<td>30</td>
<td>2.6</td>
<td>0.8</td>
<td>30</td>
<td>2.5% -6.50 (4.78, 11.52)</td>
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<tr>
<td>Aparna, 2013</td>
<td>1.71</td>
<td>0.12</td>
<td>40</td>
<td>2.33</td>
<td>0.98</td>
<td>40</td>
<td>4.0% -6.65 (4.60, 6.61)</td>
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<td>Ar, 2012</td>
<td>2.4</td>
<td>0.5</td>
<td>10</td>
<td>2.8</td>
<td>0.7</td>
<td>10</td>
<td>10.0% -8.64 (4.21, 16.54)</td>
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<tr>
<td>Barren-Conner, 1996</td>
<td>2.15</td>
<td>0.55</td>
<td>150</td>
<td>3.21</td>
<td>0.64</td>
<td>1100</td>
<td>3.9% -7.04 (6.64, 1.16)</td>
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<tr>
<td>Buchmann, 2015</td>
<td>2.46</td>
<td>0.48</td>
<td>91</td>
<td>2.99</td>
<td>0.32</td>
<td>605</td>
<td>20.6% -6.13 (4.22, 0.32)</td>
<td></td>
</tr>
<tr>
<td>Cian, 2017</td>
<td>3.8</td>
<td>0.4</td>
<td>10</td>
<td>3.3</td>
<td>0.7</td>
<td>9</td>
<td>1.3% 0.16 (0.42, 0.21)</td>
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<tr>
<td>Chiacco, 2006</td>
<td>3.046</td>
<td>0.948</td>
<td>69</td>
<td>3.2</td>
<td>0.8</td>
<td>45</td>
<td>2.6% -0.16 (0.42, 0.21)</td>
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<tr>
<td>Denevic, 2008</td>
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<td>0.73</td>
<td>262</td>
<td>2.83</td>
<td>0.68</td>
<td>262</td>
<td>3.7% -0.11 (0.23, 0.01)</td>
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</tr>
<tr>
<td>Dhawadkar, 2011</td>
<td>1.16</td>
<td>0.88</td>
<td>40</td>
<td>1.56</td>
<td>0.46</td>
<td>40</td>
<td>3.0% -6.52 (4.73, 0.31)</td>
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<tr>
<td>Gueato, 2002</td>
<td>3.15</td>
<td>0.48</td>
<td>15</td>
<td>3.59</td>
<td>0.47</td>
<td>15</td>
<td>21.1% -6.43 (4.78, 0.16)</td>
<td></td>
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<tr>
<td>Guarner, 2003</td>
<td>2.46</td>
<td>0.67</td>
<td>25</td>
<td>2.7</td>
<td>0.92</td>
<td>12</td>
<td>11.1% -0.34 (0.83, 0.33)</td>
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</tr>
<tr>
<td>Jainala, 2014</td>
<td>2.07</td>
<td>0.64</td>
<td>20</td>
<td>2.7</td>
<td>0.44</td>
<td>20</td>
<td>24.4% -0.06 (0.18, 0.04)</td>
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<td>Kartikay, 2017</td>
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<td>247</td>
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<td>0.41</td>
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<td>Kleine, 2012</td>
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<td>0.74</td>
<td>585</td>
<td>2.49</td>
<td>0.93</td>
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<td>Lira, 2004</td>
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<td>0.53</td>
<td>40</td>
<td>2.81</td>
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<td>24.8% -0.94 (0.33, 0.35)</td>
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<td>Malecka, 2002</td>
<td>2.16</td>
<td>0.6</td>
<td>12</td>
<td>2.58</td>
<td>0.31</td>
<td>12</td>
<td>32.0% -6.03 (4.64, -0.22)</td>
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<td>Melia, 2003</td>
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<td>0.6</td>
<td>17</td>
<td>3.1</td>
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<td>Marz, 2006</td>
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<td>0.8</td>
<td>32</td>
<td>3.07</td>
<td>0.98</td>
<td>40</td>
<td>4.0% -6.61 (4.47, -0.56)</td>
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<td>Nandwani, 2012</td>
<td>1.97</td>
<td>0.48</td>
<td>45</td>
<td>2.27</td>
<td>0.5</td>
<td>47</td>
<td>21.1% -6.00 (4.50, 0.10)</td>
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<tr>
<td>Nicholoson, 2017</td>
<td>2.01</td>
<td>0.48</td>
<td>100</td>
<td>2.37</td>
<td>0.38</td>
<td>100</td>
<td>27.3% -6.39 (4.40, -0.24)</td>
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<td>Oost, 2008</td>
<td>2.3</td>
<td>0.57</td>
<td>58</td>
<td>2.57</td>
<td>0.8</td>
<td>52</td>
<td>23.8% -6.27 (4.49, -0.59)</td>
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<tr>
<td>Ortega-Aguilar, 2006</td>
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<td>0.55</td>
<td>144</td>
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<td>0.1</td>
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<td>4.1% -6.30 (4.32, 0.20)</td>
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<tr>
<td>Ozob, 2010</td>
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<td>0.74</td>
<td>101</td>
<td>2.58</td>
<td>0.62</td>
<td>104</td>
<td>3.2% -6.52 (4.46, 0.38)</td>
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<tr>
<td>Rajani, 2013</td>
<td>2.91</td>
<td>0.64</td>
<td>40</td>
<td>3.34</td>
<td>0.49</td>
<td>40</td>
<td>2.7% -6.33 (4.68, -0.68)</td>
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<td>Shergill, 2017</td>
<td>3.43</td>
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<td>50</td>
<td>3.05</td>
<td>0.83</td>
<td>50</td>
<td>20.0% -6.60 (4.67, -0.13)</td>
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<td>Verna, 2009</td>
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<td>0.53</td>
<td>50</td>
<td>2.2</td>
<td>0.49</td>
<td>50</td>
<td>21.1% -6.27 (4.47, -0.47)</td>
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<td>Webb, 2008</td>
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<td>0.11</td>
<td>9</td>
<td>2.27</td>
<td>0.34</td>
<td>7</td>
<td>26.8% -6.42 (4.60, -0.16)</td>
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</tr>
<tr>
<td>Wild, 2017</td>
<td>2.68</td>
<td>0.59</td>
<td>60</td>
<td>2.73</td>
<td>0.6</td>
<td>65</td>
<td>30.0% -0.07 (0.27, 0.03)</td>
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<td>Yeh, 2008</td>
<td>2.73</td>
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<td>110</td>
<td>2.86</td>
<td>0.94</td>
<td>18162</td>
<td>4.0% -6.12 (4.10, -0.14)</td>
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<td>Zanjani, 2000</td>
<td>2.6</td>
<td>0.7</td>
<td>31</td>
<td>2.6</td>
<td>0.6</td>
<td>15</td>
<td>16.1% -6.50 (4.60, -0.12)</td>
<td></td>
</tr>
</tbody>
</table>

Total (95% CI): 3759

Heterogeneity: Tau² = 0.03, Chi² = 353.83, df = 33 (P < 0.00001), I² = 94%

Test for overall effect: Z = 6.59 (P < 0.00001)
Figure S2. Forest plot of forced vital capacity (L)
Figure S3. Forest plot of forced expiratory flow between 25% and 75% of total lung capacity (L/s)

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Type 2 diabetes</th>
<th>Control</th>
<th>Mean Difference IV, Random, 95% CI</th>
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</thead>
<tbody>
<tr>
<td>Abd El-Atteya, 2013</td>
<td>1.4 0.5</td>
<td>30 2.51 0.34</td>
<td>40 10.6%</td>
</tr>
<tr>
<td>Aghamoh, 2010</td>
<td>2.72 0.73</td>
<td>30 2.82 0.53</td>
<td>15 8.7%</td>
</tr>
<tr>
<td>Arandhalsakshari, 2013</td>
<td>2.2 1 30 2.6 1.1</td>
<td>36 7.6%</td>
<td>-0.47 [-0.80, -0.14]</td>
</tr>
<tr>
<td>Art, 2002</td>
<td>2.6 0.8</td>
<td>25 3.35 0.8</td>
<td>10 6.7%</td>
</tr>
<tr>
<td>Jamaica, 2014</td>
<td>2.75 1.01</td>
<td>50 3.3 1.38</td>
<td>30 6.2%</td>
</tr>
<tr>
<td>Malta, 2003</td>
<td>2.6 1</td>
<td>17 3.6 1.2</td>
<td>17 5.9%</td>
</tr>
<tr>
<td>Nair, 2006</td>
<td>2.96 0.26</td>
<td>22 3.66 0.18</td>
<td>44 11.2%</td>
</tr>
<tr>
<td>Nandhini, 2012</td>
<td>2.62 0.7</td>
<td>45 3.07 0.69</td>
<td>47 9.9%</td>
</tr>
<tr>
<td>Olu, 2018</td>
<td>2.46 0.88</td>
<td>50 2.59 0.7</td>
<td>52 10.5%</td>
</tr>
<tr>
<td>Raiti, 2015</td>
<td>2.16 0.03</td>
<td>40 2.57 1.01</td>
<td>40 8.4%</td>
</tr>
<tr>
<td>Venosa, 2005</td>
<td>2.79 1.23</td>
<td>50 2.89 0.9</td>
<td>50 8.6%</td>
</tr>
<tr>
<td>Zennan, 2001</td>
<td>2.6 1</td>
<td>31 2.9 0.9</td>
<td>18 8.5%</td>
</tr>
<tr>
<td>Total (95% CI)</td>
<td>438</td>
<td>387</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Heterogeneity: Tau² = 0.12, Chi² = 69.84, df = 11 (P < 0.0001); I² = 64%
Figure S4. Forest plot of peak expiratory flow (L/s)

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Type-2 Diabetes Mean</th>
<th>SD</th>
<th>Total</th>
<th>Control Mean</th>
<th>SD</th>
<th>Total</th>
<th>Weight</th>
<th>Mean Difference IV, Random, 95% CI</th>
<th>Mean Difference IV, Random, 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abd El-Aziz, 2015</td>
<td>3.26</td>
<td>0.6</td>
<td>30</td>
<td>5.92</td>
<td>1.7</td>
<td>20</td>
<td>40</td>
<td>5.2%</td>
<td>-1.64 [-2.97, -2.31]</td>
</tr>
<tr>
<td>Agarwal, 2013</td>
<td>5.47</td>
<td>1.41</td>
<td>20</td>
<td>5.96</td>
<td>1.07</td>
<td>15</td>
<td>5.1%</td>
<td>-0.49 [-1.24, 0.25]</td>
<td></td>
</tr>
<tr>
<td>Ananthakrishnan, 2013</td>
<td>5.2</td>
<td>2</td>
<td>20</td>
<td>8.2</td>
<td>1.7</td>
<td>30</td>
<td>45</td>
<td>4.5%</td>
<td>-1.00 [-1.94, 0.00]</td>
</tr>
<tr>
<td>Apathy, 2013</td>
<td>4.36</td>
<td>0.31</td>
<td>40</td>
<td>5.92</td>
<td>0.5</td>
<td>40</td>
<td>6.5%</td>
<td>-1.59 [-1.72, -1.46]</td>
<td></td>
</tr>
<tr>
<td>Avi, 2002</td>
<td>5.7</td>
<td>1.7</td>
<td>28</td>
<td>7.25</td>
<td>2.5</td>
<td>30</td>
<td>10</td>
<td>2.7%</td>
<td>-1.06 [-2.09, 0.00]</td>
</tr>
<tr>
<td>Chawla, 2011</td>
<td>5.12</td>
<td>1.01</td>
<td>40</td>
<td>0.07</td>
<td>2.51</td>
<td>40</td>
<td>4.5%</td>
<td>-0.90 [-1.62, 0.02]</td>
<td></td>
</tr>
<tr>
<td>Gommer, 2003</td>
<td>5.53</td>
<td>2.26</td>
<td>25</td>
<td>5.86</td>
<td>1.55</td>
<td>12</td>
<td>3.7%</td>
<td>-0.65 [-1.45, 1.10]</td>
<td></td>
</tr>
<tr>
<td>Jamnathan, 2014</td>
<td>4.93</td>
<td>1.96</td>
<td>30</td>
<td>7.23</td>
<td>1.53</td>
<td>30</td>
<td>4.6%</td>
<td>-2.27 [-3.27, -1.47]</td>
<td></td>
</tr>
<tr>
<td>Milani, 2002</td>
<td>4.33</td>
<td>0.6</td>
<td>12</td>
<td>5.84</td>
<td>0.53</td>
<td>12</td>
<td>6.0%</td>
<td>-1.51 [-1.93, -1.09]</td>
<td></td>
</tr>
<tr>
<td>More, 2006</td>
<td>5.77</td>
<td>0.46</td>
<td>32</td>
<td>9.31</td>
<td>0.28</td>
<td>40</td>
<td>6.4%</td>
<td>-1.14 [-1.32, -0.96]</td>
<td></td>
</tr>
<tr>
<td>Nandini, 2012</td>
<td>6.97</td>
<td>1.37</td>
<td>45</td>
<td>7.32</td>
<td>1.46</td>
<td>47</td>
<td>5.6%</td>
<td>-0.73 [-1.31, -0.15]</td>
<td></td>
</tr>
<tr>
<td>Nichkiass, 2012</td>
<td>3.795</td>
<td>0.734</td>
<td>100</td>
<td>4.11</td>
<td>0.986</td>
<td>100</td>
<td>6.4%</td>
<td>-0.22 [-1.11, -0.12]</td>
<td></td>
</tr>
<tr>
<td>Ozar, 2019</td>
<td>5.17</td>
<td>1.51</td>
<td>50</td>
<td>5.43</td>
<td>1.51</td>
<td>52</td>
<td>5.6%</td>
<td>-0.26 [-0.93, 0.31]</td>
<td></td>
</tr>
<tr>
<td>Ortiz-Aquino, 2008</td>
<td>4.6</td>
<td>0.2</td>
<td>144</td>
<td>6.4</td>
<td>0.2</td>
<td>139</td>
<td>0.5%</td>
<td>-4.40 [-6.45, -5.35]</td>
<td></td>
</tr>
<tr>
<td>Ozari, 2010</td>
<td>5.6</td>
<td>2.24</td>
<td>101</td>
<td>5.31</td>
<td>1.52</td>
<td>104</td>
<td>5.7%</td>
<td>-6.71 [-1.25, -6.17]</td>
<td></td>
</tr>
<tr>
<td>Rajani, 2013</td>
<td>5.41</td>
<td>2.27</td>
<td>40</td>
<td>5.97</td>
<td>1.72</td>
<td>40</td>
<td>4.7%</td>
<td>-1.10 [-1.95, -0.22]</td>
<td></td>
</tr>
<tr>
<td>Shergill, 2017</td>
<td>8.73</td>
<td>1.22</td>
<td>50</td>
<td>9.86</td>
<td>1.80</td>
<td>50</td>
<td>5.6%</td>
<td>-1.12 [-1.70, -0.54]</td>
<td></td>
</tr>
<tr>
<td>Van Eijkelen, 2018</td>
<td>5.51</td>
<td>3.38</td>
<td>110</td>
<td>7.85</td>
<td>2.2</td>
<td>75</td>
<td>4.4%</td>
<td>-2.24 [-3.31, -1.17]</td>
<td></td>
</tr>
<tr>
<td>Van, 2009</td>
<td>5.17</td>
<td>1.68</td>
<td>50</td>
<td>5.56</td>
<td>1.68</td>
<td>50</td>
<td>5.6%</td>
<td>-0.37 [-1.05, 0.30]</td>
<td></td>
</tr>
</tbody>
</table>

Total (95% CI): 992 / 986; 100.0% / 100.0% / -1.67 [-1.43, -0.71]

Heterogeneity: Tau² = 0.52; Chi² = 526.67, df = 19 (P < 0.000001); I² = 97%
Test for overall effect: Z = 6.92 (P < 0.000001)
Figure S5. Forest plot of diffusion capacity of the lungs for carbon monoxide (mL/min/mm Hg)

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Type-2 diabetes</th>
<th>Control</th>
<th>Mean Difference IV, Random, 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abd El-Atteer, 2013</td>
<td>13.87</td>
<td>1.9</td>
<td>30</td>
</tr>
<tr>
<td>Agarwal, 2010</td>
<td>19.56</td>
<td>5.37</td>
<td>30</td>
</tr>
<tr>
<td>Anandharikankari, 2013</td>
<td>19.07</td>
<td>3.7</td>
<td>30</td>
</tr>
<tr>
<td>Caron, 2017</td>
<td>26.6</td>
<td>5.6</td>
<td>10</td>
</tr>
<tr>
<td>Chawan, 2012</td>
<td>23.7</td>
<td>5.6</td>
<td>15</td>
</tr>
<tr>
<td>Klein, 2012</td>
<td>15.72</td>
<td>5.1</td>
<td>30</td>
</tr>
<tr>
<td>Klein, 2012</td>
<td>20.57</td>
<td>5.53</td>
<td>46</td>
</tr>
<tr>
<td>Matsubara, 1981</td>
<td>15</td>
<td>4.8</td>
<td>52</td>
</tr>
<tr>
<td>Salt, 2008</td>
<td>23.8</td>
<td>6.8</td>
<td>58</td>
</tr>
<tr>
<td>Zannettou, 2001</td>
<td>21.6</td>
<td>4.6</td>
<td>31</td>
</tr>
<tr>
<td>Total (95% CI)</td>
<td>1120</td>
<td>4160</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Heterogeneity: Tau² = 5.30; Chi² = 129.43, df= 9 (P < 0.0001); P = 93%
Test for overall effect Z = 3.81 (P < 0.0001)
Figure S6. Funnel plot of FEV$_1$ (L), FVC (L), FEF$_{25-75\%}$ (L/s), PEF (L/s) and DL$_{CO}$ (mL/min/mm Hg)