ISPOR Panel, Tokyo Sep 2018: The Productivity-Adjusted Life Year (PALY)

Danny Liew
Productivity-Adjusted Life Year

'productivity index' = 0.8

1 year lived with condition

examples of tools:

- work, productivity and activity impairment (WPAI)
- health and labour questionnaire (HLQ)
- work limitations questionnaire (WLQ)
- Endicott work productivity scale (EWPS)
The Productivity Burden of Diabetes at a Population Level

Dianna J. Magliano,1,2 Valencia J. Martin,1
Alice Owen,1 Ella Zomer,1 and Danny Liew1

Methods

• Australian cohort with diabetes (NDSS), aged 20-65 years

• simulated follow-up via life table modelling until 69 years

• same cohort remodelled, but assumed no diabetes
  – mortality and productivity improved
  – effect of diabetes on productivity1: 1.3% absenteeism,
    6.6% presenteesim → ‘productivity index’ = 0.921

Diabetes in Australia

Magliano et al. *Diabetes Care*. 2018

**Table 1**—Model population at baseline from the NDSS diabetes population in 2011

<table>
<thead>
<tr>
<th>Age-group (years)</th>
<th>Men Population</th>
<th>Men People with diabetes</th>
<th>Men Diabetes Prevalence</th>
<th>Women Population</th>
<th>Women People with diabetes</th>
<th>Women Diabetes Prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>20-24</td>
<td>823,470</td>
<td>3,665</td>
<td>0.0045</td>
<td>788,193</td>
<td>3,484</td>
<td>0.0044</td>
</tr>
<tr>
<td>25-29</td>
<td>841,084</td>
<td>4,480</td>
<td>0.0053</td>
<td>817,086</td>
<td>4,554</td>
<td>0.0056</td>
</tr>
<tr>
<td>30-34</td>
<td>769,211</td>
<td>6,285</td>
<td>0.0082</td>
<td>766,950</td>
<td>6,487</td>
<td>0.0085</td>
</tr>
<tr>
<td>35-39</td>
<td>782,204</td>
<td>9,995</td>
<td>0.0128</td>
<td>791,706</td>
<td>10,580</td>
<td>0.0134</td>
</tr>
<tr>
<td>40-44</td>
<td>786,748</td>
<td>17,201</td>
<td>0.0219</td>
<td>800,496</td>
<td>18,915</td>
<td>0.0236</td>
</tr>
<tr>
<td>45-49</td>
<td>764,167</td>
<td>26,352</td>
<td>0.0345</td>
<td>777,690</td>
<td>26,538</td>
<td>0.0341</td>
</tr>
<tr>
<td>50-54</td>
<td>739,627</td>
<td>40,196</td>
<td>0.0543</td>
<td>754,436</td>
<td>35,721</td>
<td>0.0473</td>
</tr>
<tr>
<td>55-59</td>
<td>662,069</td>
<td>53,970</td>
<td>0.0815</td>
<td>673,924</td>
<td>42,872</td>
<td>0.0636</td>
</tr>
<tr>
<td>60-64</td>
<td>611,198</td>
<td>68,667</td>
<td>0.1123</td>
<td>614,802</td>
<td>51,146</td>
<td>0.0832</td>
</tr>
<tr>
<td>65-69</td>
<td>474,253</td>
<td>78,092</td>
<td>0.1547</td>
<td>480,007</td>
<td>56,098</td>
<td>0.1169</td>
</tr>
</tbody>
</table>

7,254,011 308,903 4.3% 7,265,290 256,395 3.5%

Diabetes and PALYs

Magliano et al. *Diabetes Care*. 2018

**Table 4**—PALYs lived, simulated from life table modeling

<table>
<thead>
<tr>
<th>Age-group (years)</th>
<th>Population with diabetes</th>
<th>Population assumed not to have diabetes</th>
<th>Percent reduction in PALYs: nondiabetes versus diabetes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Men</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20-24</td>
<td>149,907</td>
<td>168,192</td>
<td>12.2</td>
</tr>
<tr>
<td>25-29</td>
<td>163,504</td>
<td>183,658</td>
<td>12.3</td>
</tr>
<tr>
<td>30-34</td>
<td>202,012</td>
<td>227,066</td>
<td>12.4</td>
</tr>
<tr>
<td>35-39</td>
<td>278,292</td>
<td>312,816</td>
<td>12.4</td>
</tr>
<tr>
<td>40-44</td>
<td>405,969</td>
<td>459,949</td>
<td>12.3</td>
</tr>
<tr>
<td>45-49</td>
<td>513,981</td>
<td>575,447</td>
<td>12.1</td>
</tr>
<tr>
<td>50-54</td>
<td>613,728</td>
<td>685,619</td>
<td>11.7</td>
</tr>
<tr>
<td>55-59</td>
<td>734,910</td>
<td>819,514</td>
<td>11.5</td>
</tr>
<tr>
<td>60-64</td>
<td>479,172</td>
<td>538,874</td>
<td>10.4</td>
</tr>
<tr>
<td>65-69</td>
<td>210,325</td>
<td>230,046</td>
<td>9.4</td>
</tr>
<tr>
<td>Total (men)</td>
<td>3,749,408</td>
<td>4,189,182</td>
<td>11.6</td>
</tr>
<tr>
<td><strong>Women</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20-24</td>
<td>146,353</td>
<td>162,501</td>
<td>11.0</td>
</tr>
<tr>
<td>25-29</td>
<td>170,940</td>
<td>189,908</td>
<td>11.1</td>
</tr>
<tr>
<td>30-34</td>
<td>214,729</td>
<td>238,589</td>
<td>11.1</td>
</tr>
<tr>
<td>35-39</td>
<td>303,697</td>
<td>337,303</td>
<td>11.1</td>
</tr>
<tr>
<td>40-44</td>
<td>460,515</td>
<td>510,906</td>
<td>10.9</td>
</tr>
<tr>
<td>45-49</td>
<td>531,374</td>
<td>588,377</td>
<td>10.7</td>
</tr>
<tr>
<td>50-54</td>
<td>561,729</td>
<td>620,210</td>
<td>10.4</td>
</tr>
<tr>
<td>55-59</td>
<td>490,248</td>
<td>539,230</td>
<td>10.0</td>
</tr>
<tr>
<td>60-64</td>
<td>364,097</td>
<td>398,645</td>
<td>9.5</td>
</tr>
<tr>
<td>65-69</td>
<td>152,506</td>
<td>166,174</td>
<td>9.6</td>
</tr>
<tr>
<td>Total (women)</td>
<td>3,396,188</td>
<td>3,751,843</td>
<td>10.5</td>
</tr>
<tr>
<td>Total</td>
<td>7,150,596</td>
<td>7,931,024</td>
<td>11.1</td>
</tr>
</tbody>
</table>

Total 7,150,596 7,931,024 11.1
Productivity burden of smoking in Australia: a life table modelling study

Alice J Owen,¹ Salsabil B Maulida,¹,² Ella Zomer,¹ Danny Liew¹

Methods

- cohort of smokers, 20-65 years, followed up until 69 years
- prevalence of smoking from National Health Survey
- same cohort remodelled, but assumed not smoking
  - reduced mortality¹
  - prod. indices² = 0.957 non-smokers, 0.932 smokers

### Prevalence of Smoking in Australia

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Males N</th>
<th>% smoking</th>
<th>N</th>
<th>% smoking</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>20-24yr</td>
<td>851,818</td>
<td>16.2%</td>
<td>137,995</td>
<td>17.3%</td>
<td>139,721</td>
</tr>
<tr>
<td>25-29yr</td>
<td>885,390</td>
<td>25.5%</td>
<td>225,774</td>
<td>14.2%</td>
<td>124,068</td>
</tr>
<tr>
<td>30-34yr</td>
<td>876,875</td>
<td>25.5%</td>
<td>223,603</td>
<td>14.2%</td>
<td>124,108</td>
</tr>
<tr>
<td>35-39yr</td>
<td>785,670</td>
<td>22.2%</td>
<td>174,419</td>
<td>14.1%</td>
<td>111,427</td>
</tr>
<tr>
<td>40-44yr</td>
<td>819,943</td>
<td>22.2%</td>
<td>182,027</td>
<td>14.1%</td>
<td>117,793</td>
</tr>
<tr>
<td>45-49yr</td>
<td>774,379</td>
<td>20.7%</td>
<td>160,296</td>
<td>17.2%</td>
<td>135,761</td>
</tr>
<tr>
<td>50-54yr</td>
<td>769,307</td>
<td>20.7%</td>
<td>159,247</td>
<td>17.2%</td>
<td>135,649</td>
</tr>
<tr>
<td>55-59yr</td>
<td>714,584</td>
<td>18.3%</td>
<td>130,769</td>
<td>12.9%</td>
<td>94,990</td>
</tr>
<tr>
<td>60-64yr</td>
<td>632,862</td>
<td>18.3%</td>
<td>115,814</td>
<td>12.9%</td>
<td>84,307</td>
</tr>
<tr>
<td>65-69yr</td>
<td>570,582</td>
<td>11.1%</td>
<td>63,335</td>
<td>6.9%</td>
<td>40,225</td>
</tr>
<tr>
<td>TOTAL</td>
<td>7,681,410</td>
<td>20.5%</td>
<td>1,573,278</td>
<td>14.3%</td>
<td>1,108,050</td>
</tr>
</tbody>
</table>

### Smoking and PALYs

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Males PALYs lost to smoking</th>
<th>% PALYs lost</th>
<th>PALYs lost per smoker</th>
</tr>
</thead>
<tbody>
<tr>
<td>20-24yr</td>
<td>247,604</td>
<td>5.7%</td>
<td>1.8</td>
</tr>
<tr>
<td>25-29yr</td>
<td>380,994</td>
<td>6.0%</td>
<td>1.7</td>
</tr>
<tr>
<td>30-34yr</td>
<td>346,165</td>
<td>6.3%</td>
<td>1.5</td>
</tr>
<tr>
<td>35-39yr</td>
<td>239,675</td>
<td>6.6%</td>
<td>1.4</td>
</tr>
<tr>
<td>40-44yr</td>
<td>211,217</td>
<td>6.9%</td>
<td>1.2</td>
</tr>
<tr>
<td>45-49yr</td>
<td>149,449</td>
<td>7.2%</td>
<td>0.9</td>
</tr>
<tr>
<td>50-54yr</td>
<td>109,286</td>
<td>7.4%</td>
<td>0.7</td>
</tr>
<tr>
<td>55-59yr</td>
<td>57,992</td>
<td>7.5%</td>
<td>0.4</td>
</tr>
<tr>
<td>60-64yr</td>
<td>26,076</td>
<td>7.4%</td>
<td>0.2</td>
</tr>
<tr>
<td>65-69yr</td>
<td>3,766</td>
<td>6.2%</td>
<td>0.1</td>
</tr>
<tr>
<td>All males</td>
<td>1,772,214</td>
<td>6.4%</td>
<td>1.1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Females PALYs lost to smoking</th>
<th>% PALYs lost</th>
<th>PALYs lost per smoker</th>
</tr>
</thead>
<tbody>
<tr>
<td>20-24yr</td>
<td>144,023</td>
<td>4.5%</td>
<td>1.0</td>
</tr>
<tr>
<td>25-29yr</td>
<td>118,851</td>
<td>4.7%</td>
<td>1.0</td>
</tr>
<tr>
<td>30-34yr</td>
<td>108,518</td>
<td>5.0%</td>
<td>0.9</td>
</tr>
<tr>
<td>35-39yr</td>
<td>86,319</td>
<td>5.2%</td>
<td>0.8</td>
</tr>
<tr>
<td>40-44yr</td>
<td>77,198</td>
<td>5.3%</td>
<td>0.7</td>
</tr>
<tr>
<td>45-49yr</td>
<td>72,214</td>
<td>5.5%</td>
<td>0.5</td>
</tr>
<tr>
<td>50-54yr</td>
<td>54,838</td>
<td>5.7%</td>
<td>0.4</td>
</tr>
<tr>
<td>55-59yr</td>
<td>25,928</td>
<td>6.0%</td>
<td>0.3</td>
</tr>
<tr>
<td>60-64yr</td>
<td>13,065</td>
<td>6.1%</td>
<td>0.2</td>
</tr>
<tr>
<td>65-69yr</td>
<td>1,975</td>
<td>5.1%</td>
<td>0.0</td>
</tr>
<tr>
<td>All females</td>
<td>702,931</td>
<td>5.0%</td>
<td>0.7</td>
</tr>
<tr>
<td>TOTAL</td>
<td>2,475,144</td>
<td>6.0%</td>
<td>1.0</td>
</tr>
</tbody>
</table>

Owen et al. *Tobacco Control*. 2018
Cost of PALYs

“... cost for each PALY ... derived from Australian gross domestic product (GDP) in 2016 (AU$1,474,705 million) divided by the estimated number of equivalent full-time (EFT) workers (9,411,998) ... AU$157,000.”

“... the total cost of productivity loss attributable to smoking was estimated to be AU$388 billion over the working life of the current Australian population.”

Limitations

- ‘non-dynamic’ models
- non-existence of condition vs reversal
- crude estimations of productivity indices
- undiscounted
- how can PALYs inform decision-making?
PALY vs QALY

- less subjective measurement
- biased towards working-age people
- intrinsic monetary value (societal perspective)
- less comparable across countries

Thank You

ありがとうございました