The impact of smoker status on mortality risks

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Hannover Life Re Africa
Agenda

1. Introduction and data sources
2. Prevalence of smoking
3. Distribution of deaths by smoker status
4. Impact of smoking on mortality rates
Introduction

Aims

• Prevalence
  • Provide prevalence statistics for various populations

• Causes of death
  • Do causes of deaths differ by smoker status?

• Mortality rates of smokers and non-smokers
  • Does a difference exist?
  • What is the magnitude of the relative risk (RR)?
  • Does RR depend on age, gender, rating class etc?
  • Does RR differ for various causes of deaths?
Introduction

Summary of data sources

• Insured lives
  • Hannover Life Re Africa data (HLRA) : 2005 - 2009
  • Continuous Statistical Investigations (CSI): 1999 - 2002
  • Continuous Mortality Investigations Bureau (CMIB): 1999 - 2003

• Population data
  • South African Demographic and Health Survey (SADHS): 2003
  • Health Survey for England (HSE): 2006
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## Prevalence of smoking

### Overview

<table>
<thead>
<tr>
<th>Assured lives</th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medically underwritten lives in South Africa (HLRA data)</td>
<td>28%</td>
<td>20%</td>
</tr>
<tr>
<td>Assured lives in South Africa (CSI data)</td>
<td>34%</td>
<td>19%</td>
</tr>
<tr>
<td>Assured lives in the United Kingdom (CMIB data)</td>
<td>21%</td>
<td>19%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Population (above age 20)</th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>South African population (SADHS data)</td>
<td>35%</td>
<td>10%</td>
</tr>
<tr>
<td>United Kingdom population (HSE data)</td>
<td>24%</td>
<td>21%</td>
</tr>
</tbody>
</table>
Prevalence of smoking
Prevalence in different data sources for males
Prevalence of smoking
Prevalence by socio-economic class for males

<table>
<thead>
<tr>
<th>Socio-economic class</th>
<th>HLRA</th>
<th>CSI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class 1</td>
<td>24%</td>
<td>25%</td>
</tr>
<tr>
<td>Class 2</td>
<td>34%</td>
<td>33%</td>
</tr>
<tr>
<td>Class 3</td>
<td>40%</td>
<td>36%</td>
</tr>
<tr>
<td>Class 4</td>
<td>44%</td>
<td>34%</td>
</tr>
</tbody>
</table>
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Distribution of deaths
Analysis of lives below age 40

- Smoking impact on mortality
  - Must be acting through accidental risk
  - Males: impact may be similar for accidental and natural deaths
  - Females: impact may be greater for accidental deaths
Distribution of deaths
Analysis of lives above age 40

- Smoker impact greater for natural causes than accidental
Distribution of deaths

Summary

- Death risks for smokers aged below 40
  - Males: Accidental deaths significant
    - Natural deaths possibly have significance
  - Females: Accidental deaths potentially more significant
- Death risks for smokers aged above 40
  - Natural risks more important for smokers
- Modelling and analysis considerations
  - Gender and age differential
  - Cause of death differential
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Analysis of mortality rates
Overview of methods - GLM

- Measures analysed
  - ‘all cause’, ‘accidental’, and ‘natural’ death rates

- Generalised linear models (GLM)
  - Applied to the HLRA data
  - A model of the number of deaths
  - GLM defined by
    - Poisson assumption of errors
    - Log link function
    - Linear predictor
      - Age, gender, smoker status, duration, socio-economic class
      - Two way interaction of these factors (e.g. smoker and gender)
Analysis of mortality rates
Overview of methods – ratio of rates analysis

- Consider two independent Poisson variables $X_N$ and $X_S$ with corresponding parameters $\mu_N$ and $\mu_S$.
- Define $\rho$ as the ratio of the two rates: $\rho = \frac{\mu_S}{\mu_N}$.
- Observe deaths $x_S$, $x_N$ and exposures $E_S$, $E_N$.

- Estimate of $\rho$ is $\frac{x_S \cdot E_N}{E_S \cdot x_N}$.
- Approx 95% CI is $\frac{E_N}{E_S} \left\{ \frac{2x_S x_N + 1.96^2 \cdot x \pm \sqrt{1.96^2 \cdot x \cdot (4x_S x_N + 1.96^2 x)}}{2x_N^2} \right\}$.

Analysis of mortality rates
Ratio of ‘accidental’ rates - HLRA males

• GLM results – HLRA data
  • Ratio: $\rho = \frac{\mu_S}{\mu_N} = 1.48$, 95% CI: $[1.33:1.68]$
  • Age, gender, SEC and duration not significant in ratios

• Check using ratios of crude rates
  • No comparable data from other data sets available
  • Ratios by age and gender

<table>
<thead>
<tr>
<th>Broad age group</th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>Below age 40</td>
<td>161%</td>
<td>164%</td>
</tr>
<tr>
<td>Above age 40</td>
<td>131%</td>
<td>147%</td>
</tr>
</tbody>
</table>
Analysis of mortality rates
Ratio of ‘all cause’ rates

- GLM results – HLRA data
  - Difference is significant and depends on age
    | Age | 20  | 30  | 40  | 50  | 60  | 70  |
    |-----|-----|-----|-----|-----|-----|-----|
    | Relative risk for smokers | 1.58 | 1.73 | 1.88 | 2.05 | 2.24 | 2.44 |
  - Differs by duration: e.g. age 40: 1.56 (duration 0), 1.88 (ultimate)
  - Gender and SEC not significant in ratio

- Is gender independence reasonable
  - No comparable data from other data sets available
  - Consider age and gender specific ratios
    - HLRA data
    - CSI data
Analysis of mortality rates
Ratio of ‘all cause’ rates - CMIB

Ratio of smokers to non-smokers mortality rates

Age group
Males ratio 95% LCL for males 95% UCL for males Females ratio
Analysis of mortality rates

Ratio of ‘all cause’ rates - CSI males

- Ratio of smokers rates higher for males
  - Is the difference due to gender?
  - GLM model on CSI data would provide insight
Analysis of mortality rates
Ratio of ‘natural causes’ rates - HLRA data

- Ratio:

<table>
<thead>
<tr>
<th>Age</th>
<th>20</th>
<th>30</th>
<th>40</th>
<th>50</th>
<th>60</th>
<th>70</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relative risk for smokers</td>
<td>1.26</td>
<td>1.52</td>
<td>1.83</td>
<td>2.20</td>
<td>2.64</td>
<td>3.18</td>
</tr>
</tbody>
</table>

- Gender impact may be present but not statistically significant
Conclusion

- Smokers have higher mortality rates
- Accidental causes deaths
  - Risk is estimated at 1.48 that of non-smokers
  - Does not depend on age and gender
- Natural causes deaths
  - Risk rises with age, depends on duration
  - Does not depend on gender and SEC
- GLM on CSI, CMIB studies required to confirm results