Does smoking impact your mortality?

Introduction

Your smoking habits influence the premium that you pay for obtaining life cover. The majority of life assurance companies around the world use smoker status as an established rating factor in the pricing of life assurance risks. Along with age, gender, socio-economic class and duration since underwriting, smoker status is an important indicator of the magnitude of the risk when pricing death, dread disease and disability covers.

The price of a life policy must reflect the risk that a particular individual represents and when we consider smoker status as one of these risks, a number of questions arise:

- Is there a difference between the mortality rates of smokers and non-smokers?
- If this difference exists, what is the magnitude?
- Does the level of the difference depend on policyholder characteristics such as age, gender and socio-economic class?
- Does the impact of smoking differ by product type e.g. ‘accidental death’ cover only
- What assumptions should be used to obtain ‘aggregate’ rates from separate non-smoker and smoker rates?

The last question above requires an understanding of the prevalence of smoking in groups of people. The remainder of the questions relate to the relative risk

An estimated 25% of the medically underwritten, assured population can be classified as smokers

Information as of March 2014
of smoking and the impact on the insurance risk of the particular policyholder. Similar questions arise in the pricing of critical illness and disability products.

The use of an ‘aggregate’ rate is required when an insurer is unable or unwilling to charge different rates for smokers and non-smokers. All else being equal, this implies that non-smokers, who most likely present a lower mortality risk, pay the same premium as smokers (i.e. a cross-subsidy exists). If the insurer has reliable ‘smoker’ and ‘non-smoker’ mortality rates, then it is important to use the correct prevalence assumptions when combining these two sets of rates to obtain a single, ‘aggregate’ rate.

Differentiated pricing, using smoker status, occurs when an insurance company charges different rates for smokers and non-smokers. Each group is charged separately for their insurance costs and there is no cross-subsidy between these groups. In this case, developing a good understanding of the relative risk of smoking and the impact on insurance risks is more important than knowing and understanding the prevalence patterns.

This article aims to share observations with respect to smoking patterns and their impact on death claims, obtained from assured lives data held by Hannover Life Reassurance Africa Limited (HLRA). These observations, and the resulting conclusions, can be used to provide answers to some of the questions presented above and they serve as a basis for setting pricing assumptions.

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### Smoking patterns

#### Overall patterns

From our analysis, we estimate that 25% of the medically underwritten, assured population can be classified as smokers. The table on this page shows how the proportion of smokers differs by gender and how the HLRA values compare with information from other published sources.

#### Smoking prevalence for assured and general population lives

<table>
<thead>
<tr>
<th>Assured lives</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Medically underwritten lives in South Africa</td>
<td>28%</td>
<td>20%</td>
</tr>
<tr>
<td>b) Assured lives in South Africa</td>
<td>34%</td>
<td>19%</td>
</tr>
<tr>
<td>c) Assured lives in the United Kingdom (UK)</td>
<td>21%</td>
<td>19%</td>
</tr>
</tbody>
</table>

#### Population (Above age 20)

<table>
<thead>
<tr>
<th>Population (Above age 20)</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) South African population (2003)</td>
<td>35%</td>
<td>10%</td>
</tr>
<tr>
<td>b) United Kingdom (UK) population (2006)</td>
<td>24%</td>
<td>21%</td>
</tr>
</tbody>
</table>

* These calculations were performed based on the published data to obtain comparative figures (only lives older than age 20 are included in these figures)

The HLRA proportion of smokers for males is lower than that observed in the data in the Actuarial Society Assured Lives mortality investigation 1999-2003 (referred to as CSI data). However the proportion of smokers in both these data sets is lower than that in the general South African population (as given in the Demographic and Health Survey 2003).

HLRA females have a lower proportion of smokers than the males. This observation is also consistent with age, gender, socio-economic class and duration since underwriting, smoker status is an important indicator of the magnitude of the risk when pricing death, dread disease and disability covers.
with the CSI data. However, females that have life cover have a significantly higher proportion of smokers than the general population.

The South African insured lives proportion of smokers is more consistent with the UK population figures.

**Age and gender patterns**

There are significant differences in the proportion of smokers between different age groups. The proportion of smokers at younger ages is higher than at the older ages in assured lives. Graph 1 shows the proportion of smokers by age group and gender observed in the HLRA data. Males show a greater decrease in the prevalence of smoking as age increases compared to that observed for females.

The smoking pattern by age, observed in the CSI study\(^1\) is different from our results. In the CSI study, the 40 to 49 year age group has the highest proportion of smokers with 37% for males and 21% for females. In contrast, the HLRA data shows peak proportions in the youngest (20 to 29) age group. These proportions are 36% for males and 23% for females. The CSI results are also consistent with the figures from the Demographic and Health survey\(^3\), which also has the highest proportion of smokers in the 40 to 49 age group, albeit at a higher level for males (45%) and a lower level for females (14%).

Assured lives in the UK show that the highest proportion of smokers are observed at the older ages (above 50 years) according to our calculations based on the CMIR 23 report\(^3\). These peak proportions are about 23% for males and 20% for females.

**Socio-economic class patterns**

Smoking patterns have also been analysed by socio-economic class. In the HLRA data the proportion of smokers, for males, in the least wealthy classes is almost double that of the wealthiest classes. A significantly smaller difference is observed between the proportions of smokers in these classes for the CSI data. All of the classes in the CSI data, apart from the wealthiest class, have a similar proportion of smokers for males. The proportions of smokers do not differ much between various socio-economic groups for females.

**Summary**

The above analyses show that the different population subgroups exhibit different smoking patterns by age and gender. It is therefore important to understand the specific profile (age and gender) of the target market when performing a pricing exercise. The commonly used assumption, in the South African market, that smokers constitute 30% of the assured lives population may not always be appropriate, particularly for females or at the older ages.

The proportion of smokers at younger ages is higher than at the older ages in assured lives.
Impact of smoker status on insurance risks

Impact on claim causes

The impact of smoker status on the mortality risk can partly be analysed by considering how the causes of claims differ between smokers and non-smokers. Comparison of these differences provides an insight into which causes and risk factors differ by smoker status and which are likely to have an impact on mortality. The results of such comparisons cannot, on their own, provide evidence of the effect of smoking on mortality risks. An analysis of mortality rates is required to achieve this objective. However, analysis of differences in the causes of death by smoker status assists in identifying the main factors that need to be considered.

An analysis of causes of death is done separately for males and females and by general age group. Only deaths with known causes are used in this analysis.

Ages below 40

The analysis of causes of deaths for lives below 40 identifies three main assertions regarding the impact of smoking on mortality. These will be discussed below and will be tested based on the mortality rates in the next sections. The distribution of claims for males younger than age 40 for both smokers and non-smokers are shown in Graph 2.

Assertion 1: It is observed that accidental causes of death dominate for both smokers (83% of total claims) and non-smokers (82% of total claims). Consequently the proportion of natural deaths is low in both instances. This dominance of accidental causes of death is also observed for females (especially for female smokers) as seen in Graph 3. The conclusion derived from this is that if accidental causes are such an important cause of death and if smokers have a higher mortality risk than non-smokers then the smoking impact must, in some way, be manifesting through the accidental death risk.

Assertion 2: A feature for males in Graph 2 is that the proportions of the three broad causes of death are similar between smokers and non-smokers. In other words, a difference in smoker status does not translate into a difference in the contribution of various causes of deaths. Therefore, should smokers have an elevated mortality risk, then smoking (as a cause or as a proxy for other causes) may be associated with an increase of a similar magnitude for both the natural and the accidental risk components of the overall mortality risk.

Assertion 3: Graph 3 shows that for females, smokers have a higher proportion of deaths arising from accidental causes than is the case for non-smokers. This is different to that observed for males. Consequently it appears that being a female smoker increases the risk of accidental death more significantly than it increases the risk of death from natural causes. This implies that smoker status acts as an important proxy for some behavioural and / or lifestyle aspects influencing the mortality risk.
Ages above 40

Graph 4 shows the proportion of deaths by major causes for males older than age 40. For these ages, natural causes accounts for a higher proportion of deaths than accidental causes, for both smokers and non-smokers. The proportion of natural deaths observed is greater for smokers than for non-smokers. Analysis of the graph for females (not shown) shows that similar features apply to their causes of death.

Any differences in the mortality rates between smokers and non-smokers are likely to be driven more by natural causes than by accidental causes. Therefore, at these ages, it appears that smoking influences mortality mainly through disease processes.

Conclusions arising out of the analysis above require that the impact of smoking on mortality should be considered separately for ‘natural’ causes’ and ‘accidental causes’. In addition, the impact that age and/or gender plays in this risk should be investigated.

Impact on claim rates

The results of the analysis on the causes of death performed above make it reasonable to conclude that smoking has an impact on both the ‘natural causes’ mortality risk as well as on the ‘accidental causes’ death risk. The level and nature of these elevated risks are explored in this section by considering the crude mortality rates. This analysis employs statistical methods, including GLM, to achieve an understanding of how the mortality rates are affected by various factors. Such methods are important, particularly, where the factors interact with each other in their impact on mortality.

Accidental causes

The accidental death rates for smokers and non-smokers are calculated separately for males and females. The overall ratios of the smoker rates to the non-smoker rates for accidental death claims are shown in Graph 5. In both cases the ratio is greater than 100%, indicating that the smoker rates are higher than the non-smoker rates. While this may appear to indicate that the impact of smoking on
Accidental death rates is more for females than males, this feature is not confirmed by the results of the modelling performed on the data.

GLM modelling confirms that smokers have an ‘accidental’ mortality risk that is higher than non-smokers. However the models do not support the hypothesis that the ratio is different between males and females. Based on the data set used, it is estimated that this elevation of risk is of magnitude 148% and that there is a 95% probability that the true ratio lies between 133% and 165% of the risk for non-smokers. Both the ratios shown in Graph 5 fall within this interval. In addition, there is no evidence from our research that this elevation of risk (due to smoker status) depends on age.

Natural causes

The results of the analysis of ‘natural cause’ mortality risk also show an elevated risk for smokers relative to non-smokers. However, unlike the ‘accidental cause’ risk, the risk elevation differs with age but does not depend on gender or socio-economic class.

Age

Graph 6 shows the ratio of smokers ‘natural causes’ mortality rates to those for non-smokers, based on our data. This is shown separately for males and females. This indicates that the risk for smokers is generally higher than that for non-smokers.

The use of the GLM allows us to interpret the results in Graph 6 in light of other factors such as socio-economic class and duration since underwriting. Our modelling confirms that an elevated risk of mortality due to smoking increases with increasing age. As an example, for lives underwritten more than three years ago, the ‘natural causes’ risk of a smoker aged 30 is approximately 150% that of a non-smoker of the same age. For lives aged 60, the ratio would be in excess of 250%. These statistical analysis tools are also used to investigate the difference of the impact of smoker status by gender.

Graph 6 shows that the impact is generally lower for females than males and modelling estimates that the extra risk for female smokers should be about 85% of the extra risk for male smokers. Crucially, however, the model suggests that this difference is not statistically significant. As a result it is concluded that there is no evidence, based on the data analysed, to support the difference in the ratios for males and females observed in Graph 6.
Prevalence: The prevalence of a condition is the total number of cases of the risk factor, e.g. smokers, in a defined population at a given time or the total number of cases in the population, divided by the number of individuals in the population.

Relative risk: The risk of an event (or of developing a disease) relative to exposure to that risk.

Medically underwritten: This relates to life assurance products where the applicant is assessed based on questions and tests of a medical nature to determine any existing conditions.

Socio-economic class: The grouping of people according to educational qualifications and earnings.

GLM: Generalised Linear Model. A type of statistical modelling that allows the simultaneous investigation of various variables using general regression methods.

Duration since underwriting: The number of years that have elapsed since a policy was medically underwritten.

Statistically significant: In statistics, this indicates that a result is unlikely to have occurred by chance.

Modelling: This is a statistical process where a set of data is used to predict possible future outcomes of the condition being investigated.

Assured lives: Members of the population that have some form of life assurance and form part of the insured group of people.

Accidental death: A death resulting from accidental causes such as motor vehicle accident and violent actions.

Natural death: A death resulting from purely natural causes such as a disease.

Other analyses
A similar exploration can be done on how smoking risks are affected by duration since underwriting and socio-economic class, among other factors.

Summary and conclusion
The proportion of smokers differs significantly by the age and gender of assured lives. Different groups within the population, and within the assured lives, exhibit their own smoking patterns. It is therefore important to correctly assess the suitability and appropriateness of assumptions used for the prevalence of smoking.

The impact of smoking differs between the risk of accidental deaths and of natural deaths. This was shown for both the claim causes and the death rates. For accidental deaths, the impact of smoking impacts at the same level across all subgroups of the assured lives. This is after allowing for accidental death risk due to other factors such as age and gender. The impact on natural deaths increases with increasing age. A GLM analysis of larger data sets is required to assess the age shape of the extra mortality risk that arises due to smoking.

Smoking should be appropriately allowed for in the pricing and valuation assumptions for individual life business. Equally analysis should be done to correctly understand the impact of other factors such as age, gender, duration since underwriting, socio-economic class and occupation class on mortality. The use of multivariable techniques like GLM on data sets like the CSI data and the CMIB data would greatly enrich the understanding of the influence of these important rating factors on mortality and on other insurance risks.

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References

2 CMIR 23 (2009), Graduations of the 1999-2002 Life Office Mortality Experiences
3 Department of Health, Medical Research Council, OrcMacro. 2007. South Africa Demographic and Health Survey 2003. Pretoria: Department of Health
5 Source: Hannover Life Reassurance Africa Limited data

Life Trends

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