Females vs. males

It is well known that in the general population females have higher life expectancy than males. Not surprisingly, female disabled lives also survive longer than males in general. This effect is illustrated in Figure 1, which shows cumulative survival curves obtained via the product limit estimator by Kaplan-Meier for female and male disabled lives based on the given data.

The curve for females is less steep than males. The data shows 76% of female disabled lives survived the first year of needing care, compared to just 59% of males; 41% of females survived the fifth year of needing care, compared to 22% of males.

The fact that female disabled lives outlive males is also revealed by the mean survival time (observed until the end of the observation period). On average female patients survive 1,030 days from the point of claim, compared to 695 days for males. Therefore, it still makes sense for European insurers to analyse mortality behaviour by gender despite having being obligated to offer unisex premium rates since December 2012. This article also considers females and males separately.
Analysed risk factors

Besides gender, age at claim and pathology were studied as explanatory variables towards survival behaviour of disabled lives. Special attention was paid to the pathology of cancers and the pathology of neurological and dementia diseases. As the pathology of cancers would be expected to have the highest mortality by far, especially at point of claim, a model was considered where the mortality for cancer cases was analysed in comparison to other pathologies. Also, since LTC products may include cognitive impairment as a benefit trigger, the mortality rate of disabled lives with neurological or dementia diseases was studied in comparison to the remaining pathologies within the group of non-cancer disabled lives.

Survival analysis depending on pathology

For the analysed portfolio of disabled lives, six groups of pathologies were distinguished and claims were classified under one of the groups as follows:

- **CANC**: All cancers, tumours and symptoms of malignant cell degeneration
- **DSEN**: Alzheimer’s disease, senile dementia and all related illness (e.g. tetrapyradimal syndrome)
- **NEUR**: All neurological diseases (in particular Parkinson’s disease and multiple sclerosis)
- **CARD**: All cerebrovascular and cardiac accidents and the consequences thereof (e.g. hemiplegia, tetraparesis)
- **POLY**: All multiple pathologies for which no particular one has caused the others (no main pathology)
- **OTHER**: All other pathologies that are too rare in the sample to form a category on their own and that are not related to the five categories listed above

The pathology NEUR and the pathology DSEN are the most present disorders, followed by CANC (see Table 1).

Characteristics of disabled lives survival behaviour

Disabled lives mortality is influenced by certain risk factors, or explanatory variables. Besides gender, one might think of pathology and age at point of LTC claim as significant risk factors. Moreover, it is well known that disabled lives mortality decreases significantly in the first months of needing care and depends strongly on the time elapsed since point of claim. Hence, one might expect the impact of those risk factors to evolve over time. To quantify these ideas further, a statistical model was used that specializes in differences in survival behaviour between certain groups (e.g. cancer patients vs. non-cancer patients, or patients having different ages at point of claim) and in tracking the evolution of these differences over time (cf. Cox’s regression model).

A statistical model allows drawing conclusions on mortality rates beyond the observation time. In addition, it allows analysis of the influence of certain risk factors on the survival behaviour of disabled lives. Often the lifetime distribution is not necessarily of interest, but how it varies between certain values of these factors is.
Apart from pathology at point of claim, the claimant may develop further disorders later in time. Although subsequent disorders do influence survival, their effects could not be assessed by this study.

**Cancer vs. non-cancer pathologies**

It might be intuitive that cancer patients, on average, do not live as long as non-cancer patients. More precisely, the given data reveals that in females the mean survival time (observed until the end of the observation period) is 311 days for cancer patients compared to 1,171 days for non-cancer patients; in males it is 221 compared to 850 days. To quantify this over-mortality of the pathology CANC further, gender-wise, the relative risk of dying of cancer compared to non-cancer disabled lives was estimated. It was found that, particularly at the time of claim, cancer patients have higher mortality than non-cancer patients; e.g., at LTC entry the instantaneous mortality rate for a male cancer case is about seven times as high as for a male non-cancer case, and the effect is even stronger in females. It then takes some years for the mortality rates of both groups (cancer vs. non-cancer cases) to start to converge. At the end of year six the relative risk of cancer patients dying compared to non-cancer patients is still estimated to be 130% in males and 140% in females.

**Neurological and dementia disorders vs. remaining pathologies**

In the group of all non-cancer pathologies, the relative risk of death for neurological and dementia patients compared to the remaining pathologies (i.e. POLY_CARD_OTHER) was estimated, and it was seen that it is also fairly time-dependent.

The group of disabled lives with pathology NEUR_DSEN has a comparable small risk of death at beginning of LTC; for instance, at point of claim the risk of death for a male NEUR_DSEN case is just 20% of the risk of death for a male POLY_CARD_OTHER case.

However, the relative risk of death for neurological or dementia patients increases over time, and even results in higher mortality over time. In males, NEUR_DSEN cases already have higher instantaneous mortality rates than POLY_CARD_OTHER cases after approximately one year of LTC.
and the relative risk of male NEUR_DSEN patients dying compared to POLY_CARD_OTHER patients eventually attains 250%. In females, the same effect is not as strong: female NEUR_DSEN cases have higher mortality than female POLY_CARD_OTHER cases after about 28 months, and the relative risk of death eventually attains 148%.

What do the survival curves tell us?

Figures 2 and 3 show the estimated cumulative survival curves for females and males respectively (i.e. the share of survivors for each pathology group). For both genders, the survival curve for cancer cases (red curve) decreases fastest, especially at the point of claim. Here, the survival curve for neurological and dementia cases (dark blue line) is the flattest. After some time in need of care, the survival curve for neurological and dementia cases becomes steeper and intersects the survival curve of the remaining disorders (grey line), which is due to the fact that the first group develops higher mortality than the latter one over time. This effect is stronger in males than in females. The cumulative survival curves were obtained via regression analyses by Cox.5

In Figure 2 only 26% of female CANC disabled lives survived the first year of need of care compared to 89% of the NEUR_DSEN group. After about 6.25 years (2,290 days) since LTC, the share of survivors of the NEUR_DSEN group becomes less than the share of survivors of the POLY_CARD_OTHER group.

In Figure 3 only 21% of male CANC disabled lives survived the first year of need of care compared to 77% of the NEUR_DSEN group. After about 2.25 years (806 days) since LTC, the share of survivors of the NEUR_DSEN group becomes less than the share of survivors of the POLY_CARD_OTHER group.

In Figure 4, the share of survivors not only by pathology but also by gender can be seen. For each pathology group, the share of survivors is less in males than in females at any point in time during need of care.
Conclusions

Cancer has significant higher mortality than other pathologies, especially at the beginning of need of care. Thus, in general, fewer annuities will be paid to a cancer disabled live than to a non-cancer disabled live. People disabled by neurological or dementia pathologies have the lowest mortality at care entry, but their relative risk of dying (compared to other non-cancer disabled lives) increases over time. It is important to monitor the proportion of each pathology within an insured LTC portfolio and to be aware of a percentage shift to other pathologies.

Irrespective of pathology, female disabled lives in general do not die as quickly as male disabled lives. Thus, in general, more annuities will be paid to a female disabled live than to a male disabled live, and the points above for shares of pathology analogously apply to the shares of males and females within a disabled lives LTC portfolio.

Although beyond the scope of this brief article, age at claim was also studied as explanatory variable. It was seen that in the first year of LTC, younger lives have higher mortality than older ones, which might be explained by pathology at point of claim. Survival analysis depending on age at claim will, in detail, also be part of our Insurance Issues newsletter to be published in April. This newsletter will focus on more technical information about the statistical modeling and its application to disabled lives mortality.

Looking at the survival behaviour of disabled lives with certain risk factors in LTC insurance reveals that differences in survival behaviour evolve over time and are affected by gender and pathology. These findings help to understand the development of a disabled lives LTC portfolio and provide information that may be considered for pricing, reserving and underwriting issues.

Endnotes

3 Ibid, see endnote 1.
5 Ibid.

About the Author

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