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Newsletter

SCOR Global Life develops a risk factor calculator for risk assessment in life assurance based on the PROCAM study

Introduction

By **G. Müller**¹,
T. Trompetter¹,
Dr H. Schulte² and
Professor Dr G. Assmann²

¹ SCOR Global Life, Cologne.

² Assmann Foundation for Prevention (Assmann-Stiftung für Prävention), Münster.

Reinsurers provide life assurance companies with electronic underwriting manuals for the assessment of medical risks. These underwriting manuals allow insurers to determine extra mortality based on existing diseases in order to calculate the corresponding risk loading on insurance premiums. In such calculations it is particularly difficult to adequately consider interactions between illnesses and risk factors. If risk factors are considered in isolation this may lead either to excessively high premiums for policy holders or to insufficient risk premiums for the insurer. SCOR Global Life has now developed an evidence-based approach to this problem for cardiovascular risk factors. For many years numerous medical studies have examined the complex interactions of cardiovascular risk factors. In order to utilise the findings of such studies for the purpose of risk assessment, SCOR Global Life in cooperation with PrevaMed GmbH, an institute of the Assmann Foundation for Prevention in Münster, analysed the data from the Prospective Cardiovascular Münster (PROCAM) study. This collaboration also resulted in the development of an evidence-based calculator for cardiovascular risk factors that takes into consideration possible implications in terms of The General Equal Treatment Act (*Allgemeines Gleichbehandlungsgesetz*). This calculator has been integrated into SCOR Global Life's existing underwriting manual (Life Manual).

As the PROCAM data has been examined in terms of mortality, the calculator only refers to the PROCAM findings for life assurance. Risk assessment for other insurance products continues to be based solely on the existing risk assessment recommendations contained in the Life Manual. The PROCAM data allows underwriters to assess more precisely the complex interactions between risk factors. This forms the basis of evidence-based underwriting.

The following document outlines the methods used in risk assessment and describes how findings were used to construct the calculator.

Editor

Bérangère Mainguy
Tel : 33(0)1 46 98 84 73
Fax : 33 (0)1 46 98 84 07
life@scor.com

SCOR Global Life

1, avenue du Général de Gaulle
92074 Paris La Défense Cedex
France

www.scor.com

The PROCAM study

The PROCAM study is one of the largest epidemiological studies worldwide for the study of coronary heart disease. Since 1979, employees of private companies and local government authorities have been comprehensively examined for cardiovascular risk factors.

Following admission to the study participants were contacted by letter every four years and asked to complete a questionnaire to establish any new incidences of cardiovascular disease as well as mortalities.

A detailed description of the study design and exclusion criteria is contained in the paper by Assmann et al.^[1]

The risk calculator was constructed using the data of participants in the PROCAM study who had been admitted to the study before 1995 and had taken part in at least one follow-up survey. The participants were aged between 20 and 65 years at the time of recruitment to the study. The total group included 26,975 employees, of which 18,460 were men, and 8,515 were women.

Analysing the PROCAM data

For the purpose of data analysis three age groups were formed.

The Cox Proportional Hazard Model yielded four significant risk factors for each group. In the younger and middle-aged groups these were systolic blood pressure, low-density lipoprotein (LDL) cholesterol, smoking, and diabetes. In the older age group high-density lipoprotein (HDL) cholesterol replaced LDL cholesterol as a significant risk factor.

As diastolic blood pressure strongly correlated with systolic pressure, only one of the two values was included in the model. It is well established that triglycerides influence mortality from cardiovascular disease. However, as the calculator is not solely concerned with cardiovascular

causes of death, but rather with overall mortality, including for example cancer deaths and suicide, the triglycerides were judged to be non-significant in this context.

The mortality related to increased BMI of the older age groups can be fully accounted for by the above-mentioned risk factors and is therefore not regarded as an independent risk factor for mortality.

However, because the PROCAM data for the younger age group is not yet founded on a sufficiently large base of data, the estimated extramortality related to BMI for the age group up to 40 years will be incorporated into the overall estimate on a pro-rata basis, depending on the person's age, and providing all other risk factors are known.

The risk factor of smoking is defined in the PROCAM study as a dichotomous variable. For the purposes of life assurance the simple classification into smoker and non-smoker is inadequate, and the associated loss of information is problematic for risk assessment. With the help of data from the Federal Statistical Office of Germany (*Statistisches Bundesamt*)^[5] and the findings published by Nilsson et al.^[4] in a Swedish smokers' study, the smoking variable was analysed so that the influence of the number of cigarettes smoked per day on mortality was taken into account, while at the same time the risk of being a smoker as established in the PROCAM study is also retained. The diabetes variable is also defined in the PROCAM study as a dichotomous variable, whereby fasting blood sugar is included in addition to anamnestic details. In addition to the consideration of smoking risk, data from the Disease Management Programme run by the Central Research Institute of Ambulatory Health Care (*Zentralinstitut für Kassenärztliche Versorgung*)^[2] and findings of the British diabetics' study UKPDS^[6] were also used so that the HbA1c (glycated haemoglobin) value could also be included.



Applying findings to policyholders

In applying the findings of the PROCAM study to life assurance policyholders we had to bear in mind that the study was based on a different base population than that typically represented by policyholders. A direct application of the relative risk loadings to a group of policyholders would lead to insufficient absolute loadings because the total mortality of participants in the PROCAM study was higher than the total mortality in the insured group. Therefore the relative loadings were adjusted to an insured group.

A further important point in applying the findings of the PROCAM study was to weigh up the respective strengths and weaknesses of the statistical analysis and the existing electronic underwriting manual GEM. Statistical analysis is based on observed data. The PROCAM study was based on a high level of objectivity but it was also subject to random

variations, as only a random sample of the entire population was studied. By contrast, the Life Manual is based on the experiences of insurance physicians and underwriters over many years and also incorporates knowledge of the insurance market. Assessments based on the Life Manual tend to be less objective than those based on the statistical analysis, but reflect a high level of expertise.

The credibility theory^[3] was applied to combine these two approaches. This theory combines experiential values with the statistical findings in such a way that where variations increasingly arise in the statistical model it is possible to revert back to the experiential values. The influence of the Life Manual is, depending on the age group, between 19 and 28%. In this context the calculator can be regarded as an evidence-based assessment method despite partial recourse to the existing Life Manual.

Constructing the risk factor calculator

The result produced by the risk factor calculator naturally depends on how complete the available information about risk factors was.

If all of the risk factors relevant for the PROCAM-based assessment are available, then the risk factor calculator will yield a result that is weighted, as described above, on the PROCAM analysis and traditional assessment. In this case, in the over 40 age group, BMI is not regarded as an independent risk factor in the overall consideration of risk factors and is therefore not included in the Life Manual assessment.

If the values of all significant risk factors are not available then the PROCAM results cannot be used, and the result generated by the risk factor calculator is based solely on the individual assessments for the risk factors from the Life Manual. Additionally, there may be loadings for certain combinations of risk factors. BMI is also taken fully into account in this scenario.

The calculator also allows underwriters to define risk loadings for smoker and non-smoker rates.

New findings for medical risk assessment

Analysis of the PROCAM study findings is producing new results for risk assessment. It is now possible to produce an evidence-based assessment of the complex interplay of cardiovascular risk factors.

One such result is that BMI no longer needs to be separately considered where all other risk factors (at least for people aged over 40) are available and have been assessed. Excess mortality associated with obesity is already incorporated into the assessments based on the other risk factors. This is because 80% of study participants with a BMI over 30 also show other risk factors. Obesity rarely occurs in isolation and, as such, is rarely associated with increased mortality when all other risk factors are excluded.

By allowing for the interaction of risk factors it is possible to generate a more precise and distinct risk assessment than would be possible if each risk factor was considered in isolation.

This approach also means that an individual risk factor can be evaluated more favourably if all other factors are excluded. On the other hand, the existence of a metabolic syndrome or the concurrence of several risk factors is generally assessed as a higher risk according to an evidence-based assessment.

Implications for new policies

Use of the risk factor calculator in risk assessments by life assurance companies has implications for losses, risk premiums and loss ratio in new policies.

To quantify these effects, typical new life assurance policy holders (in terms of distribution of sums insured and age) were simulated and risk factors were assigned to these people. In this way it is possible to compare the risk loadings for these people before and after using the risk factor calculator. Possible changes in demand behaviour for insurance cover following use of the risk factor calculator are not considered in this test.

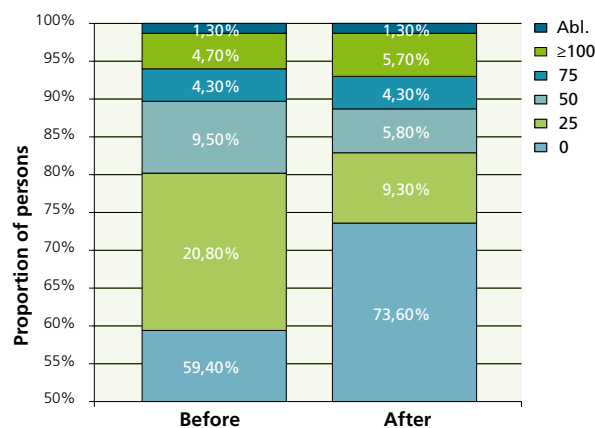
First of all, the distribution of risk loadings among persons before and after using the calculator was examined. While the percentage of people who were accepted at standard rates rose from 59% to 74% as a result of the new assessment method (Figure 1). The percentage of people with 25% or 50% extra mortality decreased from 30% to 15%. The percentage of people with loadings of 100% and higher rose slightly, while the percentage of declinations remained stable at 1%. All in all, the new assessment method does not alter the number of insurable people. Also, it shifts the lower risk loadings towards standard acceptance.

A comparison was then made between distribution of risk loadings on risk premiums before and after the calculator was used. The percentage of risk premiums without any substandard loadings rose from 45% to 58% as a result

of the new assessment method. At the same time, the percentage of premiums with risk loadings fell from 55% to 39%. This again shows an increase in the percentage of people without an extramortality risk loading. Moreover, the overall risk premiums fell from 100% to 97% for the same people, in other words by a mere 3%.

These tests illustrate that the Life Manual risk assessment method that was used up to now results in extramortality loadings that are more or less confirmed by the new, evidence-based assessment method. However, deviations may arise for individual risks.

Figure 1: Distribution of risk loadings to policy holders before and after application of the calculator



Conclusion

Analysis of the PROCAM study and application of its findings in the new risk factor calculator has made an evidence-based approach to assessing cardiovascular risk factors possible. This approach ensures a greater degree of objectivity and transparency, at least in relation to mortality. It is now possible to produce more differentiated individual assessments. As a result more

acceptances at standard rates have been achieved and a greater acceptance of offers for substandard risks with lower risk loadings can be expected. The resulting advantage in selection means that a greater number of slightly higher risks and a lower percentage of much higher risks are likely to be included in the policy portfolio.

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