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Does Preferred Wear Off?

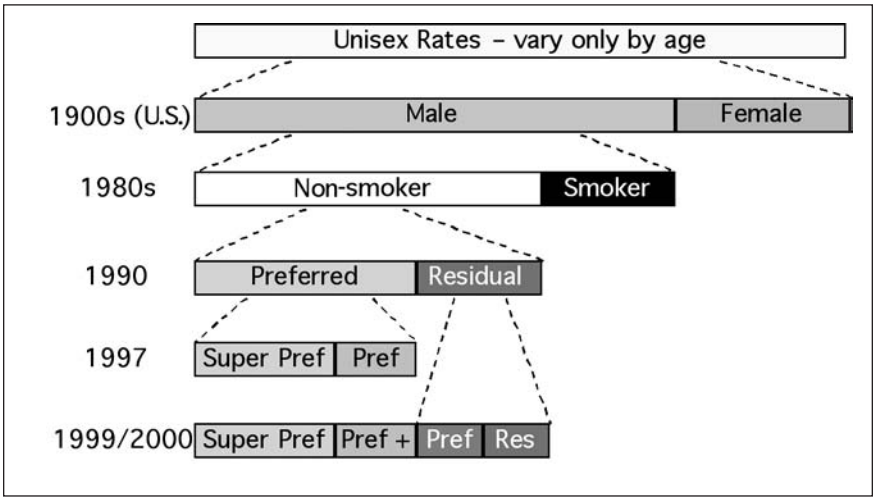
by Steve Cox

The information herein was presented to a group of clients in May 2003, reflecting years of research, experience and discussion with industry experts. The issue of whether "preferred" mortality wears off has been a frequently discussed topic in the U.S. life term market for a number of years. Because of limited insured experience studies, the discussion tends toward speculation sprinkled with mild research and insight. Presented here are a number of compelling arguments that underscore the opinion that, "No, preferred does not wear off."

What is "Preferred"?

More and more, life insurers are able to offer different prices to individuals who exhibit characteristics leading to statistically credible differences in mortality. Figure 1 shows the evolution seen in life products over the last century—more divisions, more classes and more assumptions necessary as to how these various classifications will perform mortality-wise. "Preferred," and later divisions, have arisen from the industry's ability to test various fluids at the time of underwriting, and qualification for various classes is based on factors such as blood pressure, cholesterol and family history. It is now common knowledge that "better" profiles have "better" mortality. The industry has wrestled with "how much better?" and "Does it stay better for years after underwriting?" since the advent of these more sophisticated classifications.

Figure 1



Current Opinions

As with any hypothesis, opinions abound as to the "right" answer. Pricing actuaries tend to be aggressive in their opinions, and many have priced with the discounted mortality continuing over the pricing horizon. Valuation actuaries, whether conservative by their nature or conservative by their duty, have more of a mixed view.

The latter view is given in the Canadian Institute of Actuaries Educational Note on actuarial methods, which states, "It is reasonable to assume that mortality rates for preferred and non-preferred risks would revert over time toward overall standard regular underwriting mortality rates ... it would be reasonable to assume that the effects of preferred underwriting wear off *over the select period*." [1][emphasis added] The guidelines are loosely worded, but the typical approach is to apply the preferred discount over the *experience period* [i.e., that period supported by internal or industry mortality studies], and linearly grade the discount off over the remainder of the select period.

Supporters exist for the opposing view, but evidence is limited. Further, research being conducted by the actuarial and underwriting communities will continue to form the industry view.

[1]*Canadian Institute of Actuaries Educational Note, Mortality Methods, July 2002, Section 610, p. 24*

But we know that *underwriting* wears off ...

A long-held staple of the industry's mortality assumptions is the traditional select and ultimate mortality table. Age-old industry mortality studies have verified that newly underwritten business at a particular age will exhibit better mortality than a cohort of the same age, but underwritten in prior years. However, the nature of these select and ultimate (S&U) tables is that, over time, these two cohorts underwritten at different times will eventually have the same mortality expectation, as the knowledge gained via underwriting becomes less predictive of the subgroup's mortality. This is the "wearing off" of underwriting. For a 15-year select period (as in the widely used SOA 1975-80 tables), this is saying that two people of a particular attained age, one of whom was underwritten 16 years ago, and one underwritten 25 years ago (or any number greater than 16), will have the same mortality expectations. The positive predictive value of underwriting is no longer material.

Because of the evidence that illustrates how underwriting wears off, many have leapt to the conclusion that preferred will wear off, as well. After all, preferred factors are simply some of those very factors used in underwriting to determine standard.

However, it is interesting to note what has happened over time to the select period—the period in which underwriting is deemed to still be predictive.

Table	Select Period
1930-39 Miller's Table	3
1946-49 Basic Table	15
1965-70 Table	15
1975-80 Table	15
XXX(~1995)	20 (19) grade to 3 at 84
2001 VBT	25 to age 69 6 at age 88 1 at age 92

We are seeing a lengthening of the select period in more recent mortality tables. However, research into older mortality tables shows evidence that, in fact, selection did last longer in the underlying experience, but was not incorporated into the final table. Additionally, one can argue that the advent of blood testing in the 1980s has led to a different insured population, with the value of that increased depth of underwriting leading to longer predictive power.

One element of the actuarial/underwriting process that will always impact the analysis of select periods is the analysis of the impact of lifestyle changes of the population. Certainly the industry's mortality experience is impacted by changes in smoking, dieting, and exercise habits (especially of the insured population) of the last couple of decades. Mortality table builders will always be challenged by the impact of these trends, and it is a matter of opinion how much those factors just mentioned will have on recent select periods.

Select-to-Ultimate Ratios

Another aspect of the S&U mortality table to analyze is the ratio of select-to-ultimate mortality. This is the ratio of the mortality rate of a person age 'x' who has just undergone the underwriting process, to the ratio of a person of the same age who is now in the ultimate period of the mortality table (i.e., underwritten more than 15 years ago for a table such as the 75-80 table).

Figure 2

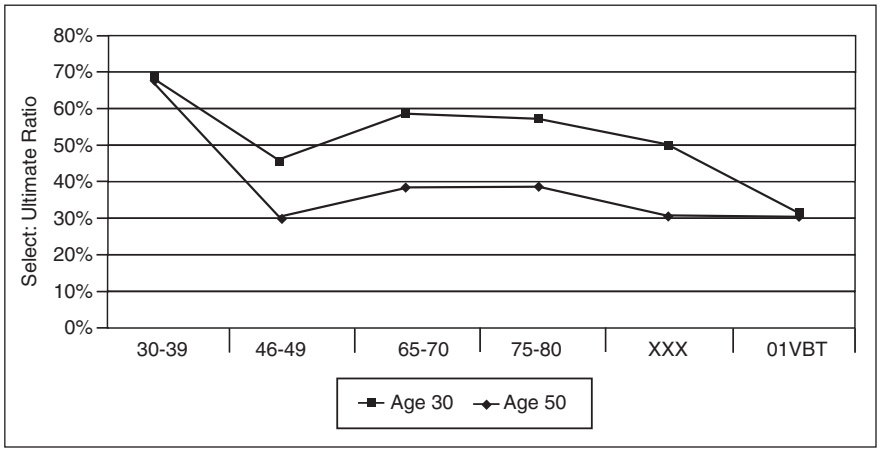


Figure 2 shows how, for the last few mortality tables, select-to-ultimate ratios have actually been fairly stable. Even with the advent of fluid testing, the S:U ratio for 50-year-olds has been substantially

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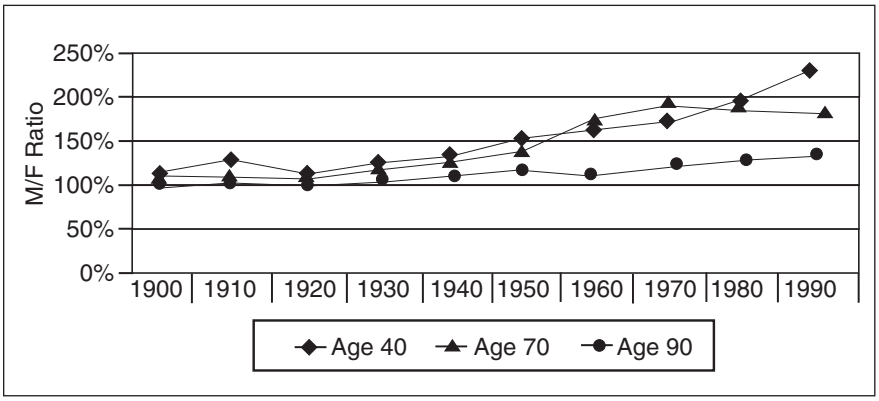
unchanged, while the younger ages have seen more predictive power gained from additional underwriting.

S:U Ratio Impact on Preferred

It is interesting to translate the S:U ratio analysis over to what it means to preferred mortality. Even for an "aggregate standard" life, underwriting has eliminated 70 percent of ultimate mortality for the first duration. One question is, how much more can be underwritten away by preferred criteria? There is a limit to this number—you cannot underwrite away all accident risk, and preferred underwriting is certainly not foolproof on all impairments.

Figure 3: Population M/F Ratios



If one believes that preferred does wear off—following the guideline mentioned earlier that all mortality reverts to overall standard—then clearly preferreds have a *lower* select-to-ultimate ratio, and therefore must have a steeper sloping mortality curve than "aggregate standard," and a *much* steeper mortality slope than their non-preferred cohort. The reasoning is obvious, since it is 'known' that preferreds have better mortality in the early years (better select mortality), but must revert back to the same ultimate mortality.

On the other hand, if one believes that preferred does *not* wear off, then the claim could easily be that both preferreds and non-preferreds have the same select-to-ultimate ratio and have the same slope on their mortality curves. This would mean that both cohorts could have 70 percent of their ultimate mortality underwritten away and have roughly parallel mortality curves.

Later in this article, we will revisit this issue as we consider mortality experience of various cohorts.

A Slight Diversion—Does Gender "Wear Off"?

The fact that female mortality is lower than male mortality is a well-documented fact. It was also big news within the last few years that the gender gap has narrowed—as measured by the difference in male versus female life expectancy from birth. After many years of the gap increasing, most recent information showed that the gap had decreased.

It is certainly revealing to look at the various ages independently. While life expectancies did slightly converge, the ratio of male mortality to female mortality increased at two of the three ages shown in the graph below. Only in the age 70 group did the male-to-female mortality ratio decrease—the fact that so much mortality occurs during those ages led to the convergence of life expectancies.

Analyzing this data as it relates to preferred requires one to examine how the male-female ratio changes by age and determine how this has developed over time. Until the 1990 data, the male-female ratio from ages 40 to 70 did *not*, in general, change. Stated otherwise, gender does not begin to "wear off" until after age 70 (Figure 3).

If the analogy can be made that preferred is similar to gender in the genetic context, and we see that gender does not "wear off" during the primary insurance ages, then one may make the leap to say that preferred does not wear off since it, too, has a strong genetic basis.

(The 1990 data for the youngest ages is interesting, but it is not obvious how much this data was impacted by AIDS mortality in young males. Additionally, the impact that female hormone treatment can play in the equation for older ages, as well as the many other confounding variables—access to health care, smoking habits by gender, women in the workplace, etc. remains to be seen)

Does Smoking Wear Off?

Perhaps it is a stretch, but one could make the argument that preferred has some similarities to smoking in the lifestyle context. That is, a person has some control over whether they are preferred or not—does he/she exercise, eat right, receive cholesterol treatment and so forth. While a stretch, it is worth discussing briefly.

Examining smoker:nonsmoker mortality ratios is a challenge—whether in insurance studies, population studies or clinical studies. As stated in the SOA's Final Report on the 2001 VBT Tables, *"First, the long-term relationship of insured lives mortality rates by smoking status is unknown. Separate smoking distinct classes have not been utilized in insurance products long enough to produce ultimate duration smoker distinct mortality. Second, the definition of smoking status has changed over time."*

To have the numbers for the sake of completeness, the 1975-80 and VBT tables both have a slight decrease in the smoker: nonsmoker mortality ratios from age 40 to 70 —from roughly 210 percent at age 40 to 160 percent at age 70. For ease of table construction, both tables have the ratio very close to 100 percent by age 90. However, because of the lack of credible definitions and data, it is difficult to rely on these numbers. Conventional wisdom is that beyond a particular age, the impact of smoking is very small, as those who have survived to that point have a genetic predisposition to dealing with the negative impact of smoking. One could easily make that same statement on preferred criteria—once a person lives to a certain age with high cholesterol, then they may very well have a genetic predisposition to deal with the negative impact of high cholesterol. But, again, the age where smoking becomes less predictive is arguably beyond the pricing horizon of mainstream preferred applicants.

Mortality Study Analysis

Of course, we are challenged by having limited industry mortality data on preferred insureds—only about a dozen years' worth. This is certainly not enough to draw conclusions about preferred wearing off.

Mortality studies are typically conducted by comparing actual mortality results to mortality results as predicted by a standard industry table (tabular mortality), such as the 1975-80 table discussed earlier. A common analysis to determine if preferred wears off is to examine the *actual-to-tabular* mortality ratios for the preferred class, by duration. For example, preferreds may show a 30 percent actual-to-tabular result for durations 1-3, then 33 percent for durations 4-6 and 40 percent for durations 7-10. These ratios would reflect the actual mortality rates experienced, divided by the mortality rates *predicted by the table.*

Typical analysis of the question at hand would be to analyze the ratios as described above. If the ratios for the preferred group increased by duration, then one might conclude that preferred is wearing off. However, this type of analysis is flawed.

First, the slope of the underlying mortality table would be pivotal in the analysis. The underlying table would have to be "right"—particularly the *slope* of the underlying table. This cuts to the heart of a hot actuarial topic—the slope of most recent industry tables is dramatically different from tables that have been the industry standard for years. In fact, the advent of preferred underwriting may very well impact that very argument, if preferred dominates the exposure in the early durations of recent industry tables.

This cuts to the heart of a hot actuarial topic—the slope of most recent industry tables is dramatically different from tables that have been the industry standard for years.

Second, since this analysis needs to be done over a number of years, how does one account for the impact of mortality improvement in the analysis? Assumptions can be made, but the impact of those assumptions would be significant.

It is my belief that examining ratios in this manner is flawed, and that a better way exists.

Recommended Approach for Examining "Wearing Off"

A much better approach is to examine the ratio of ***preferred-to-residual*** mortality results. This measures the mortality results of the preferred cohort against the mortality results of their non-preferred counterparts. This would be the *ratio* of those two groups' actual-to-tabular ratios, or the ratio of their mortality rates.

There are significant benefits to this approach. First, the results would be independent of the underlying table (assuming that issue age, gender, etc., distributions are not wildly different). Second, the issue at hand could be directly analyzed—***if the preferred-to-residual ratio converges over time, then preferred is wearing off.***

This ratio will likely start at around 65 percent (under the broad assumption of "old" mortality being 100, and preferred/residual splitting it into 80/120). If this ratio increases over a 20-duration study, then that would indicate that the two subgroups are becoming

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"more alike." It answers the fundamental question, "Does the preferred cohort stay proportionally better than its non-preferred counterparts?"

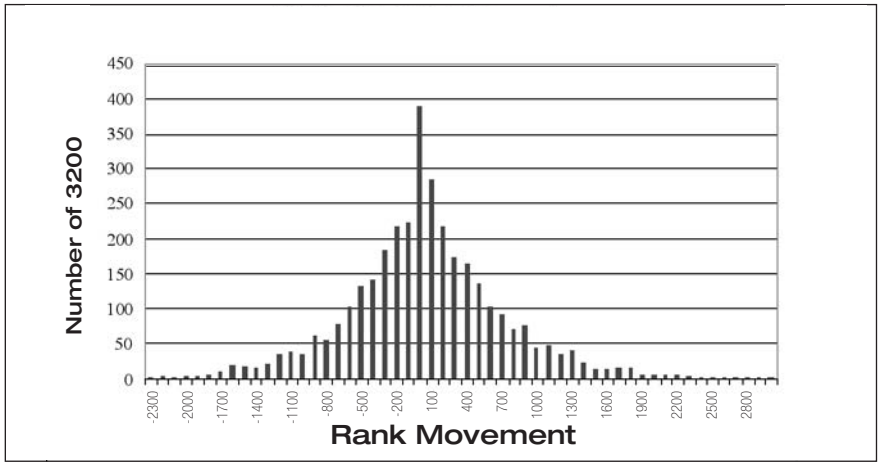
The Results Say ...

What is one to do when there is limited industry experience? One approach is to analyze clinical studies. While this approach does have its challenges, many of these challenges can be addressed, and a wealth of information exists which can help answer the question.

Framingham Study

The Framingham Study is a well-known clinical study in medical circles. This was a study commissioned by the National Institutes for Health more than five decades ago. One of the stated goals of the study was to evaluate the relationship between potential risk factors determined in healthy individuals to the subsequent development of disease and death. The focus of the study was heart disease, and it has been the origin of most of what we now know about heart disease—thousands of articles have been written based on Framingham data. A limited access dataset was obtained from the National Heart, Lung, and Blood Institute (NHLBI), the sponsor of the Framingham Study. The conclusions drawn do not necessarily represent the view of the NHLBI or the Framingham Study.

Figure 4: Relative Weight Rank Movement



The study started in 1948, when 5,209 residents of the town entered the study. Each person was tracked and examined every two years, totaling 20 examinations covering 40 years. All entrants were between the ages of 30 and 62 at the first exam.

Each exam attempted to measure scores of potential risk factors. For this project, we targeted the results for total cholesterol, HDL cholesterol, systolic blood pressure, diastolic blood pressure, Metropolitan Relative Weight (MRW), smoking status and gender. Based on these factors, we "underwrote" the dataset to get an insurable population, and tracked the results over time.

Framingham Results—Rank Movement

The first analysis is to see if those that are preferred at an early exam are still preferred at later exams. If preferred wears off, we would expect that the preferreds are somewhat randomly distributed in the population in later exams. However, if preferred does not wear off, then we would expect that the preferreds would still be relatively "better" within the cohort at later exams. For this test, we studied Exam 2 results versus Exam 10 results (16 years later).

Rather than create arguments about what to do with those who terminate in the study, those who were in the study at Exam 10 were ranked from 1 to approximately 3200 based on three different factors: total cholesterol, systolic BP and relative weight. All three return similar results, so the results from relative weight will be displayed.

After ranking based on Exam 10 results, these same entrants were ranked based on their values at Exam 2 (more values were available at Exam 2 than Exam 1). Then, the change in a person's numerical rank is determined. A histogram plotting these results is shown in Figure 4.

Of the people who were in the top half at exam 10, 79 percent were also in the top half at Exam 2. Similar results are seen for cholesterol and systolic BP, with both having results in the mid-70 percent range. This shows a strong positive correlation—if you were "good" at Exam 2, then it looks very likely that you will be "good" 16 years later at Exam 10. Yes, this is not terribly mathematical or statistical. But the purpose of this exercise was to show a strong correlation.

Can one deduce whether preferred wears off based on this? Of course not. But it is very compelling information, and does not seem to support that the preferred cohort had reverted to the aggregate cohort over a 16-year period, under the assumption that "good values" translate to "good expected mortality."

The Pivotal Information—Mortality Results from Clinical Studies

All of the information presented to this point is interesting and thought-provoking, and can lead a person to a variety of conclusions. Soft spots exist in those analyses, and applying that information to preferred mortality can be a stretch. However, it is very difficult to argue with the facts—and the facts presented here are mortality results based on clinical studies.

Certainly, one must be especially prudent when analyzing mortality results from clinical studies for the purpose of making insurance-related conclusions. Clinical studies often involve impaired individuals who would not qualify as an insured population. However, several studies do exist that study the general population, and often data is available that allows the researcher to "underwrite" the population to get an "insurable" subset of the clinical study.

Two such studies that were used for this purpose are the Framingham Study (discussed earlier), and the NHANES study. NHANES is the National Health and Nutrition Examination Survey, conducted by the National Center for Health Statistics. Four different studies have been conducted, and the NHANES II study is the most useful for these purposes.

Framingham studied 5,209 residents for over 40 years. NHANES II examined 20,322 individuals between 1976 and 1980, of which 9,250 were passively tracked through 1992 (only those between the ages of 30 and 75 at outset were tracked).

Mortality statistics were accumulated for each study. Each group was "underwritten" for qualification for "old aggregate standard" based on a number of typical insurance application criteria. This standard group was then split into a "Preferred" subgroup, and a "Residual" subgroup based on industry criteria that would be used in a traditional system. The general levels for standard and preferred are shown in Figure 5.

Recall that in the Framingham Study, each person was re-examined every two years. For purposes of this mortality study, each examination where the listed values were available created a new "entrant" into the mortality study. Additional details are available as to the methods used in tabulating exposures and deaths.

Both populations were slightly older than a typical newly insured population in the term brokerage market—52-years-old was the average entry age. Both populations were roughly 50-50 in gender distribution. Framingham was 54 percent smoker, whereas NHANES was 38 percent smoker. Lastly, 63 percent of the Framingham standard entrants qualified as preferred; NHANES sees 68 percent qualifying. These qualification percentages do not seem out of character for many companies writing preferred business.

As stated earlier, our favored method to determine the wearing off of preferred is to examine the ratio of preferred to residual mortality rates. This ratio is calculated in each population over the first 10 years of exposure, and then calculated over the period beyond year 10, up through year 20. The theory is that *if the ratio of preferred to residual mortality trends toward 1.00, then preferred wears off. If the ratio stays constant, then preferred does not wear off.* The results are displayed in Figures 6 and 7.

In both datasets, the preferred class remained proportionally better than their residual counterparts during the second decade of exposure relative to the first decade. Assuming a typical pricing horizon is 20 years, this evidence strongly suggests that the pricing process should continue to assume preferred mortality is significantly better than residual over the first 20 years.

If preferred wears off, we would expect that the preferreds are somewhat randomly distributed in the population in later exams.

Figure 5

Standard	
	Cholesterol<=320
	SBP<=160
	DBP<=95
	MRW<=174%
	Ages between 30 and 70
Preferred	
	Cholesterol<=280
	SBP<=140
	DBP<=90
	MRW<=139%

Going Beyond Year 20

NHANES, of course, does not have data beyond 20 years available. Framingham data beyond the 20th year is of questionable credibility and shows mixed results. Overall, the

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Pref:Resid ratio goes from 62 percent to 68 percent. Males show the most convergence, from 66 percent to 82 percent, while females held steady at 53 percent versus 54 percent in the prior decade.

Convergence in the third decade should not be a surprise in these datasets, given the average age at entry in the early 50s. It was shown earlier that the male:female mortality ratio begins to narrow between the ages of 70 and 90, and it was noted that one could arguably compare gender to "preferred" in the genetic context.

Summary

Certainly this analysis is not meant to replace industry studies of insured lives. One could also argue that the approach taken is not true "preferred" because, for example, family history—consistently an industry factor—is not included in the criteria. Also, the clinical groups are not insured populations.

However, until the industry develops long-term mortality experience on insured lives, we must search for clues to the right answer in all places. The data presented here provides extremely compelling evidence that over a typical pricing horizon for typical insured ages, there is no reason to believe that preferred and residual lives have converging mortality expectations. Certainly companies need to adjust this data depending on their specific markets, particularly if the company focuses on older ages or utilizes a more streamlined or simplified underwriting approach. But for mainstream products, preferred appears to not wear off. □

Figure 6: Framingham Preferred/Residual Ratios

Yrs	MN	FN	MT	FT	All
1-10	63%	55%	65%	56%	63%
11-20	66%	50%	64%	55%	62%
Yrs	**All M**	**All F**	**All NS**	**All SM**	**All**
1-10	65%	56%	60%	62%	63%
11-20	66%	54%	58%	61%	62%

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Figure 7: NHANES/Residual Ratios

Yrs	MN	FN	MT	FT	All
1-10	55%	83%	65%	43%	65%
11-20	66%	51%	70%	37%	61%
Yrs	**All M**	**All F**	**All NS**	**All SM**	**All**
1-10	61%	67%	67%	57%	65%
11-20	69%	48%	63%	54%	61%