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Insured Female Mortality -- What Is Really Happening?

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Moderator: RICHARD L. BERGSTROM

Panelists: MARY ANN BROESCH
ANNA HART†
BARBARA BLATT KALBEN

Summary: Recent path-breaking research investigates the reasons that females live longer than males in virtually all societies, and even across species. Barbara Blatt Kalben, author of the recent SOA monograph on the subject, answers questions and provides discussion on the biological and environmental factors affecting gender-based differences in mortality.

Panelists then discuss various aspects of insured female mortality, including the recent mortality studies, changes in markets, and an overview of gerontological issues.

MR. RICHARD L. BERGSTROM: Barbara Blatt Kalben began her actuarial career in Los Angeles at Transamerica in 1977. She has since been a pension consulting actuary in Edmonton, Toronto, and, since 1984, in Seattle, Washington. Anna Hart formed her own consulting business with an emphasis in medical risk and process consulting, working both domestically and internationally, in June 2001. Mary Broesch is executive director of research and consulting at ING Re where she leads the individual life, product development, and consulting area, specializing in working jointly with life insurance companies to develop term life products. Mary is a member of the Society of Actuaries' Life Insurance Mortality and Underwriting Survey Committee and the SOA Individual Life Experience Studies Committee.

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†Ms. Anna Hart, not a member of the sponsoring organizations, is with ARHart Consulting in Eastland, TX.

Note: The chart(s) referred to in the text can be found at the end of the manuscript.

MS. BARBARA BLATT KALBEN: I'm going to be talking about why men die younger. The data is based on a study I did that was supported in part by the Society of Actuaries. An abridged version was published in the *North American Actuarial Journal* in October 2000, and the full version will be published by the Society of Actuaries as a monograph and should be available in late November 2001.

I'm going to briefly discuss various different ways of looking at the sex mortality differential, the history by region, by age groups, by cause of death, and then the hypotheses that have been established to explain the difference, and a little bit about the future. Historically, there are studies from the Stone Age on whether bones or recorded tombstones are different methods of looking at mortality. Around the Middle Ages, most of these studies, although they're quite poor, have shown greater female mortality. So it's kind of the reverse of what we have now.

Starting from around the medieval period it looks like there may have been a change. The European nobility has been studied from 1330, and from that point the men have tended to have greater mortality. The first real nationwide mortality data by sex that is really a good study was in Sweden. This started the first national census in 1750. Although the life expectancy has increased over the last 250 years or so, the differential has remained amazingly stable. Even from 1751, females had a life expectancy that was about three years longer. It's been quite stable over the past 250 years or so.

Richard Price started analyzing mortality, including sex differential mortality, when he analyzed annuity contracts in 1772. He's considered the father of actuarial science. He found greater mortality amongst males than females.

I've got data that looks at the United States and Canada that goes back as far as there is really any good data. In the United States we start around 1900. The male and female life expectancies and the differential have definitely increased. It increased to about 7.7 years in 1970 and has since then decreased to about 5.7 years.

For Canada, we've got life expectancy data at age seven, starting in 1871. So this goes back a few years earlier than the U.S. data, but it is life expectancy at age seven. For the first two years that we have data for, 1871 and 1881, the life expectancy was greater for males than for females. However, thereafter the mortality has decreased. So the life expectancy has increased for both sexes, but the differential has widened, again, until the 1970s. Since the 1970s, the differential has decreased..

Now, regionally females currently have greater life expectancy in all but one of the 154 countries studied by the United Nations, and that exception is Nepal. Reasons for this exception in some places in Asia are directly correlated with female children not getting as much food as the males and not getting nearly as good health care.

Also, this relatively greater male mortality relative to females is associated with lower overall mortality. So, as the mortality rates have decreased, the differential between the sexes has tended to increase, other than for perhaps the last 20-30 years. Exceptions to that are the former Soviet Block countries where for about the past 20-30 years the difference between mortalities between the sexes has widened considerably. The Russian Federation has the greatest differential of 13.5 years currently. That has been attributed to the poor economic conditions and resulting higher incidence of alcoholism and binge drinking in males. .

Now I'm going to look at some age groups. I'm looking at current time period and primarily in the U.S., but the patterns are also very similar in all the developed countries. Males have greater mortality at all ages, including prenatal. With prenatal it's difficult to do a real good study, but it's been estimated there are 107 to 170 male conceptions for every hundred female conceptions. So, there are quite a bit more male conceptions. But at birth in the U.S. there are 105 male births to 100 female births. So, there's considerably greater male prenatal mortality than female.

I'm looking at the mortality ratios, the male divided by female at each age. The first year I have is 1900, and the ratio is very close to one. So, the mortality between the sexes is quite similar, although for the bulk of the time span from about age 30 to 90, it is greater than one. So, males do have greater mortality. When we go to 1930, it's increased a bit. There is a huge jump in 1960 and then in 1990. At age 22, it's over three times as great. This has been called the testosterone spike. In 1960 there was another hump later on in the lifespan, although it looks like it's reduced considerably from 1990. With Canada, although it's not exactly the same, you would see a similar pattern. What's interesting is that in 1991 the testosterone spike again is at exactly age 22, and it's exactly the same level. Whether that's coincidence or not, I'm not sure.

Now to get a bit into the causes of death. Of the 72 causes of death that are primary causes, five have greater female mortality. That was true in 1997. The latest data, in 1998, says that there are six. They are breast cancer, Alzheimer's Disease, asthma, rheumatic fever, complications of pregnancy and childbirth, and kidney infections. All six of these only account for less than 7 percent of the total female age-adjusted mortality. So they're really relatively few deaths caused by those.

Next I'll look at age-adjusted death rates by major causes of deaths. They're in order by the age-adjusted death rate for males. The causes are heart disease, cancer, accidents, cerebral diseases, chronic obstructive pulmonary diseases, suicide, infections and parasitic diseases, pneumonia and influenza, diabetes, homicide, and all others. So the males have greater age-adjusted death rates than females. The greatest amounts are externally caused. Suicide rates are 4.3 times more for males compared to females. Next is homicide, and then accidents.

If we were to exclude accidents and other violent deaths, that testosterone spike I spoke of earlier would totally disappear.

Now let's get into the hypotheses. There are two general categories of hypotheses to explain the sex mortality differential—internal, biological, and genetic; and the external—social, cultural, environmental, and behavioral. There's evidence to support both schools of thought. Of all the animal species studied, males have, almost without exception, greater mortality than females. The animal species studied include mealworms, nematodes, crustaceans, mollusks, insects, spiders, reptiles, birds, fish, non-primate mammals, and primate mammals.

The females tend to have lower mortality. There's a big exception—birds. That's thought to be caused by the fact that in birds it's the male who has two like chromosomes as opposed to the female who has two unlike chromosomes. It's the opposite in mammals, which I'll get to in a minute. There have also been some studies relating mortality, particularly in birds, to whether the males are monogamous or polygamous and how much the males are involved in care of the young. There appears to be a correlation between lower mortality for the males and greater care of the young.

Actually I'm going to turn back here and mention some of the others that have studied this. Allen in 1934 studied male clinic data and found higher incidence of most serious diseases among males. He wrote, again, in 1934: "The factors which are usually set down in explanation of the greater mortality of males are overwork, alcoholism, venery," which is defined as either hunting or sexual indulgence, "tobaccoism," that's a good word, "exposure to the elements, industrial hazards, and irregular habits of eating and sleeping. For each explanation of the lack of inherent vitality of the male there are objections, but these do not influence the fact the male is, by comparison with the female, a weakling at all periods of life, from conception to death. Venery, alcoholism, exposure, overwork, and various other factors may influence the susceptibility to disease and the greater mortality of the adult male, but they are only straws placed on the greater burden of the sex-linked weakness. There seems to be no doubt that, speaking comparatively, the price of maleness is weakness." That was a man that wrote that. Hamilton, in 1934, found that most pathological conditions had greater numbers in males than female.

There's no real perfect study of trying to find the explanation of mortality differential, but there's been a lot of ingenious studies that have been designed. Madison in 1957 was trying to find two groups of males and females whose lifestyles were as similar as possible so he could compare the mortality between them. He looked at people in Catholic teaching orders. He found brothers and sisters who were in the teaching orders, and had very similar characteristics. The only important characteristics he was not able to control for were smoking, alcohol use, and obesity. What he found was by considering the similar environments of the two groups of people, if anything, in fact, the mortality differential was greater than in the general population which tends to lead some evidence towards a biological

explanation of greater male mortality. Cohen studied the sex mortality differential amongst kibbutz members and had a similar finding, that they also had a greater differential, sex mortality differential, than the Jewish population in Israel.

Now, those are just some facts about male and female mortality, and here are some explanations as to why that may be the case. Females have two x chromosomes. Males have an x and a y. The y chromosome is small and has very little genetic information on it, except for what actually determines maleness. The x chromosome is much larger and has aspects that control many biological processes. It's quite advantageous. Two x chromosomes are better than one because if there's a flaw on one of the x chromosomes, typically the other x can take over. Then the individual may not have a disease that may be on one of the x chromosomes.

The chromosomes influence the so-called sex hormones. Antigens are the male hormones that are more common in males, which include testosterone. Testosterone tends to be detrimental to mortality and provokes higher blood pressure and makes the liver produce more LDL cholesterol, so-called bad cholesterol. In the early part of the twentieth century, Hamilton studied one of the ways of dealing with severe mental retardation, castration. They studied mortality in an institution and found that there was substantially lower mortality among the castrated males, along the order of 10 years longer life expectancy for the castrated males than the intact males. In fact, the earlier the castration was done, the longer the life expectancy. For every year earlier it was done, there was another 0.28 years of life expectancy for the males. Also, there's been a study of women with elevated testosterone levels. They tend to have greater mortality than other women.

Now, let's look at the so-called female hormones. Estrogen tends to make the liver produce more immunoglobins. In animal studies, testosterone treatment tended to increase thrombosis (blood clots), while estrogen treatment tends to reduce them. Estrogen also has been shown to reduce stress and allow for greater energy expenditure. Estrogens tend to make the liver produce more HDL, the so-called good cholesterol. Most studies of women who have had their ovaries removed have had increased risk of heart disease. When we get to hormone replacement therapy most of the studies have shown that women have had lower mortality, although they have basically all been observational studies, so the jury is still out as to the effect on mortality from hormone replacement therapy.

Other biological hypotheses include the iron-overload theory. Since men have more iron in their bodies than women, there's been some evidence that iron is detrimental to mortality. There's also the natural selection hypothesis, which states that the sex that has more of the responsibility of bearing and raising offspring has a built-in advantage for life expectancy.

Now, the medical and social advances that have happened in the past few hundred years have tended to favor females over males. They have addressed the standard

of living, nutrition, and then obstetrical care, which is an obvious item that has affected female mortality. All the advances have decreased female mortality considerably. As a matter of fact, in 1998, the most current year with data available in the U.S., fewer women died of complications of childbirth than males died from breast cancer. Death from childbirth is under 300 lives per year, so it's practically nonexistent.

Now in terms of the behavioral impacts, one of the biggest items is cigarette smoking. I've got data from the U.S. and also Canada. In both cases there's a big difference between smokers and non-smokers. Smokers have substantially greater mortality. Starting in 1955 and continuing to 1998, the percentage of adult males who smoked has decreased from 54 percent to 25 percent and for females has decreased from about 25 percent to 21 percent. So, although the difference is narrowing, it's decreasing for both sexes, but still more males than females smoke. If we were to put those together to get an estimate, only an estimate, mind you, of smoking-related sex mortality differentials of the three years that I have data for, it's 5.9 years, 4.9 years, and 4.5 years. Cigarette smoking is a big factor there.

Risk-taking and other behavior can also have mortality implications. Exposure to risks includes things like cigarette smoking, alcoholism, illicit drug use, and seatbelt use. Males partake in these risky behaviors more than females, although it appears to be narrowing, just like cigarette smoking. Wingard studied the effect of 17 demographic and behavioral factors and tried to isolate them in terms of sex mortality differential. When she took into consideration all 17 factors, she found a wider difference between the sexes, giving some evidence that the behavioral and demographic factors certainly do not explain all of the sex mortality differential.

There are differences between the sexes in preventive health behaviors and use of medical care. Not a lot of studies have been done, but there certainly is some difference between the sexes, although that also is narrowing. Now, labor force participation is a conventional explanation for the reasons why males have greater mortality, and, in fact, the evidence does not support this. If anything, the evidence supports the fact that the more women are in the workforce, the lower their mortality.

Sex roles have been cited as reasons for the differential, but there's little evidence to either support or refute. It's difficult to actually do these types of studies. Durand has cited evidence that men typically have lower self-disclosure than women. Goldberg has an interesting theory that unconsciously the male is afraid he can't survive without the woman. He cites evidence like greater male mortality after divorce or the death of their spouses or their mothers, that kind of thing.

So what's going to happen in the future? As mortality has decreased, the difference between males and females has widened, other than the past 20 or 30 years or so when it's tended to narrow. Probably that has been in part the result of cigarette smoking narrowing between the sexes. What do we expect to happen in the future?

There haven't been a lot of people who've been willing to discuss this, but the results have been all over the map. There are people who thought that it's going to widen further, people that thought it's going to narrow, and people who thought it's going to be stable. So we have all kinds of different explanations.

So, to conclude, there are biological, behavioral, and environmental factors that all tend to contribute, and they interrelate with each other. For example, breast cancer, which tends to be primarily a female cause of death, is also related to diet. There's this interrelationship between the biology and the behavior, and it's very difficult to pull them apart. It's also difficult to determine quantitatively the amount that each factor can contribute.

MS. ANNA HART: I'm going to speak on female mortality, some trends, comparisons, and explanations, primarily focusing more on population data, but with some direct underwriting correlations to insurance population. I'm going to cover a little bit about the 1999 death rate. I will also discuss cause of death, life expectancy, and some aging facts. My background includes work as a gerontologist. Some of my emphasis will be on the older age mortality of women—cancer, smoking, cardiovascular disease, stroke, diabetes, alcohol, and Alzheimer's. I primarily concentrated on the top three or four and why the mortality is different between men and women.

Death and death rates. There were nearly 2.4 million deaths in the United States in 1999. That was about 53,000 more than 1998. What I'm providing has gone into the crude death rate per 100,000 to give a little actuarial stuff. That would be 877 deaths per 100,000 of population. The age-adjusted death rate during 1999 was 881, so there's a difference there. One of the things I wanted to mention was that the age-adjusted death rates are constructs that show the level of mortality if there were no changes in the age composition of the population from year to year. So the age pattern for mortality varies by cause of death. The age-adjusted rates are better for examining the changes in the risk of death over time. They eliminate the influence of shifts in the age of the population. They're also better indicators of the relative risk when you compare mortality across your geographic areas or between sex and age or race subgroups that have different age compositions.

I'm on some subcommittees including the SOA Subcommittee on Mortality and Individual Life Experience Studies. We've been talking about the differential and variations in smoker/non-smoker in female mortality and why it's difficult to get an accurate cause of death on some of the data that we're getting from companies that are contributing. So, if your company is not contributing, please give your data to the Individual Life Experience Studies Committee, and we will give you a great analysis of that data.

The International Classification of Diseases (ICD-9) is typically what is used. In 1999, they transferred over to the ICD-10, and it has made a change in the top 15 causes of death in what actually is one, two and three. There has been a sort of

switching of some of the top causes. The ICD-10 gives malignant neoplasms, i.e., cancer, as the major cause. Cerebral vascular disease is the second cause. Chronic lower respiratory diseases are included. Diseases of the heart are also included. If you notice, everybody says heart disease and cancer are the top causes of death. The ICD-9-10 has caused a little bit of differentiation in the way things are classified, which, if you're putting this on a death certificate, and you're trying to use this in some of your analysis of your mortality data, you could get some differing results on your causes of death which could affect your underwriting on down the line.

Other causes are accidents, unintentional, i.e., homicide; diabetes; influenza and pneumonia; and Alzheimer's. Alzheimer's is real interesting because a lot of attention has been given to that, but the reclassification shows 33 percent more incidents. The reclassification brought it up in the causes of death where it's not really actually that much of an influence. Nephritis, that's all kidney disorders, are included, as is Septicemia.

Now, if you consider the ICD-9 causes of death, you've got heart disease as your first one. Then the ICD-9 had cancer, then cerebral vascular. The ICD-10 had cancer first, cerebral vascular, respiratory, and then heart. So, there are some fluctuations in the top five, basically. Diabetes still falls in right about the same area, and Alzheimer's, again, is the last one.

In 1980 the life expectancy was 70.7. In analyzing the data it shows that there are some real improvements in mortality in black women in some specific diseases and also in black men in specific diseases. However, the data that I discovered for 1980 had life expectancy for a male at 70.7 and a female at 78.1.

By the year 2050 you've got men with life expectancy at 79.7. Women may have a life expectancy at 84.3. Between 1950 and 1980 the gap between the life expectancy of the genders widened. Since then it's been shrinking. By the year 2050 it should be down to less than five years differential in life expectancy. Despite the fact that men do die younger, there's still a convergence toward life expectancy that's much similar.

The good news of the 1999 life expectancy data is that there are new records in life expectancy for men. . The bad news is that the female life expectancy decreased for the first time since 1995. It was interesting because there was an increased mortality for women in the areas of chronic obstructive pulmonary disease (COPD), diabetes, and hypertension that was not outweighed by the decreased mortality in some of the other causes of death. I thought it was extremely interesting. Smoking is definitely beginning to play a part for women in their mortality, and I'll get to that a little bit later. Again, the gap is narrowing. The rate is now 1.4 times greater for men than women. Life expectancy for men lags by about 5.5 years.

Trends in life expectancy. Life expectancy decreased for women for the first time since 1995, as I mentioned. It was a very small decrease of 0.1. So it's not dramatic. But this was due to increases in mortality again from chronic obstructive respiratory disease, COPD, diabetes, septicemia and hypertension that were greater than the decreases in the other causes of death. But there were decreases in cancer, stroke, suicide and homicide, and I have a theory about suicide. I actually studied death and dying when I was in graduate school. One of the papers I did was how men kill themselves versus how women kill themselves. Men take the gun, and usually very dramatically, leave a lot of blood for somebody to clean up. Women, on the other hand, take pills because they know they can actually get caught and saved in a matter of minutes. They leave the note or call right before it happens. Data supports the fact that women really don't like to use a violent method. Men tend to be more violent in the way that they eliminate themselves, and others, for that matter. Gaps between men and women continue to narrow. The death rates are greater for women, and the life expectancy for men again lags behind women, 5.5 years.

I decided to compare the life expectancies in 1993 to those in 1998, particularly to see if there was a change in heart disease and cancer. In 1993, I think heart disease was 38.4 percent of all death, and cancer was 17.7 percent. In 1998 this changed a bit. We're down to 31% of all cause of death being from heart disease. Cancer has increased, which you would expect.

Ageing factors is a very big number. I want to let you know that is a worldwide number. That is not United States. In the year 2000 there were 600 million people age 60 or over. The valuation tables are now going to go up to 120—that is being worked on. The CSO 2001 basic tables are going to go up to age 120. If you've got a population that is definitely going to be an aging population, then you have to change your policies and your product development. There are a lot of projections from the insurance industry on how we underwrite those people and how we deal with that increase in age. There will be 1.2 billion people over age 60 by the year 2025. Again, the product development potential for that will need to address long-term care, Alzheimer's, and different types of policies that will address the older-age population. A lot of that population will be women, two billion by the year 2050. So the increases are dramatic.

Today, two-thirds of all older people are living in the developed world. By the year 2025, that will be 75% of the population. The very old, 80-plus, is the fastest-growing population group in the developed world. The numbers are staggering in terms of 80-plus. Even with the centenarian, 100-plus, the numbers are growing dramatically. Women outlive men in virtually all societies. Consequently, in a very old age the ratio of women is two-to-one.

I found the age-adjusted death rates for lung cancer and breast cancer among women in the United States from 1939 to 1997 interesting. We talked to women. A lot of them think they're going to die of breast cancer or that they will get breast

cancer because there is so much emphasis given to the research and treatment of that disease. Actually, age-adjusted death rates for breast cancer are going down and have been since about 1990. Lung cancer death rates are just off the map in terms of the rates going up. Lung cancer is the leading cause of cancer death in the women. I found that really interesting. Importantly, 90 percent of all lung cancer cases in women can be attributed to smoking. Now, I know that 21 percent of women actually smoke, but the effect of the smoking on them and their mortality is very dramatic. Rates increased 20 times in women smoking two or more packs per day versus a non-smoker. So, it affects women much more dramatically. Breast cancer has been the #2 cancer cause since 1987.

Trends in cancer. The rates for all cancer again have been decreasing from 1970 to 1997. The greatest rates of decline in incidence rates have been seen in men. I think a lot of that can be attributed, of course, to some of the more increased screening methods that have come through. Particularly, I think, insurance has really assisted in that in terms of identifying things with men in prostate screening and colorectal screening that has caused some declines. Four sites account for about half of all new cancer cases—lung, prostate, breast, and colorectal cancer.

I have a friend who was diagnosed with colorectal cancer. It was Stage 4, just awful. He had been given one year to live and went through just every kind of treatment known to man. What I found interesting when I was looking at the five-year survival rate is that the highest incidence rate in all men is colorectal cancer. I know they're doing a lot of screening for that. Colorectal cancer is the second cause of cancer death among minority women, which is interesting. It is the third cancer cause of death among all women. The five-year survival rate is 61 percent, but, again, this is stage-dependent, depending on whether it's Stage 1 cancer, which is early on. Stage 1 has a 96 percent survival rate. However, if you get to Stage 4, the survival rate is 5 percent.

Smokers. Smoking is the major cause of coronary heart disease. That's no surprise to anybody. That's why there are all these people who say no smoking. The risk increases with number of packs smoked and duration. I think that is reflected by insurance companies that have preferred smoker policies. How many packs do you smoke? How many cigarettes do you smoke versus those who smoke cigars? You might actually be able to get a preferred if you smoke one per month. I've been actually seeing policies where they very specifically ask, how many do you smoke each month?

If someone starts smoking as a teenager, that person is more likely to be a smoker as he or she gets older. It's difficult for women to stop smoking. You can project a lot of reasons for that. The good news is that the risk dramatically reduces one to two years from the time they stop.

Consequences. Women are also at risk for stroke and brain hemorrhage. These are consequences of smoking. Once again, the rate is reduced once the cessation is

obtained. After 5-15 years, and this is for pricing, the risk approaches baseline. If you're going to look at somebody in terms of re-pricing or reducing ratings, -then there are some statistics that say you've got to wait a few years before you can actually take that smoker rating off. They come back. They say they haven't smoked in a year. If they come back in five years and are still not smoking, then take your rating off because then you're more approaching a baseline. It is a strong predictor for progression of carotid disease (stroke) and it is the primary cause of COPD.

Smoking prevalence. I want to point out that it's education-based. If you look at the educational rate for women who smoke, you will see that there is a high prevalence of current smoking if they only have 9-11 years of education.

Smoking conclusions. The gender gap is decreasing. Prevalence rates are related to education levels. The prevalence is also higher among minorities. It is very high among some Asians and some blacks as well. Smoking-related disease is epidemic still.

Let's look at women with heart disease and strokes. A major emphasis has been placed on science and policy. I found it interesting that the published data that I looked at showed that there's a great difference between male and females related to the diagnosis and treatment of a patient with coronary vascular disease (CVD). Treatments vary, and they have different dose effects and side effects in women versus men. The contribution of CVD rates to mortality and morbidity are underestimated in women. One of the reasons is that definitions are important. Women present differently with cardiovascular disease than do men. Men seem to be much more dramatic in presentation. There are different symptoms in women than men, so often it's not caught as quickly. The diagnostic tests for women are less effective. Breast tissue plays a part in some of the things that they're able to differentiate. The complications are higher and can be attributed again to presentation at an older age. We also need to consider the co-morbid factors that women often present with. Women do not receive the same treatment as men, and that again, is partly from the disease presentation. Education and economic resources determine access to care.

With CVD, women are protected at the younger ages. Again, this is the effect of estrogen, but their risk rapidly increases with age. Risk increases with hormone factors. Menopause is when you start seeing a dramatic increase in the mortality from CVD. By 75 to 85 years of age, their risk approaches that of men. Short-term mortality is higher for women.

There are major modifiable coronary heart disease risk factors. Again, the top one should be tobacco smoking, whether it's male or female. Hypertension is next. Cholesterol is on the list, and, of course, all insurance companies have HDL and cholesterol ratios that they pay attention to. Diabetes is the fourth modifiable coronary heart disease risk factor. Body mass index is not mentioned as frequently,

but in terms of preferred policies we've made recommendations on some of the committees that body mass index be used as a factor for preferred because it's a major factor. Diet and physical activity are also modifiable. There are additional risk factors that I would just like to list; homocysteine levels, fibrinogen levels, antioxidant levels, decreased social status, psychosocial factors (hostility, depression, lack of social sport, etc.), and environmental tobacco uses. That is often underestimated, the effect of second-hand smoking.

Hormone replacement therapy reduces the mortality from coronary heart disease. That depends on your family history. If you're a woman, different types of cancer can result if you are on hormone replacement therapy if you have a certain type of history. You have to be careful. In post-menopausal women, hormone replacement therapy can modify your cardiac risk factors up to 50 percent in the risk of developing CHD and a reduction in overall mortality, which has implications for underwriting, but you have to weigh the risks.

There are two types of diabetes. There's Type I and Type II, depending on insulin-dependent or adult onset. Over the last 40 years the median life expectancy of Type I diabetes has increased 15 years. Due to heart and kidney dysfunctions, cardiovascular mortality rates are higher in people with diabetes. It's a definite co-morbidity factor. Prevalence of CVD was 28.7 percent versus 16.3 percent in a diabetic versus a non-diabetic. People with diabetes have the highest cardiovascular event rates, but they benefit most from intervention. So there's an emphasis on early treatment. Cardiovascular mortality increases as diabetic kidney disease increases, and that's obvious. Intensive glucose control is essential to prevention of the diabetic complications. Type II diabetes is again receiving attention. Some of the lab tests are starting to really put emphasis on the albumen levels. Some companies are paying a lot of attention to that as well in trying to identify diabetics with real risk for progression to earlier mortality.

There's a lot of controversy about some of the ace inhibitors out there. They tout it as a brand-new drug that would do all sorts of wonderful things to improve cardiovascular disease. The problem is it had some very bad side effects that caused men to die, so they've pulled that off the market.

For alcohol consumption, the percentage of adults with excess alcohol consumption was 9.2 percent in early 2001. There's a definite under-evaluation in rating individuals who indicate excessive alcohol consumption. Now, the problem is the female data is very slim in terms of numbers. So, there's a lot more investigation that needs to be done, and the mortality gain is worse in women.

Alzheimer's is moving up in the basic causes of death. Basically it's getting a lot of publicity. A lot of new drugs are being tried. If you are on Aricept, it does not cure you. It just delays your input into an LTC facility. It slows the mental deterioration and the ultimate mortality, although you will die of it. It'll just take you a little bit longer. The time of death varies depending upon the course of the disease.

Underwriting modifications. Should we evaluate women differently than men? Yes, we probably should. Can we get away with that? Probably not. Should there be a modification of underwriting requirements? Yes, we can do that. We can look at things a little bit differently. Can we use some new underwriting tool? That seems like a pharmaceutical database. We can look at things like individual activities of daily living, activities of daily living, and social interaction. Do the person have a pet? Yes. That makes a difference. We can consider more lifestyle factors to be very important.

Conclusions. Both males and females are living longer. The historical pattern shows that women live longer than men. Again, good news—men are catching up or it's going to converge eventually if we all live long enough. While mortality for all diseases is higher for men, and the greatest impact again is cardiovascular disease, diabetes, and stroke, the most modifiable risk factor continues to be smoking because it influences every disease across the board.

Future. There are a lot of new drugs. The FDA comes out every year with a list of new drugs. The problem is there has been so much pressure to get these drugs out on the market quickly as new treatment. A lot of the side effects aren't realized until you're already using it, and some of the side effects are worse than not having taken the drugs at all. A lot of the new treatments are out there being touted. You've got to have money. You've got to have access. And if you're not on the top-ten list, you're not going to get it. So, a lot of the treatments are geared to people who can afford them, and we've seen that in a lot of the underwriting that we do. Again, more emphasis is being placed on modifiable risk factors.

MS. MARY ANN BROESCH: I'm going to bring this back to the insured population since we're actuaries, and my concern is how we price for this, and what do we look at? I'm going to cover the recent experience that the Society of Actuaries has put out looking at both the 1990-95 and the 2001 Valuation Basic Tables. We've seen much more improvement at the younger and middle issue ages. In females, there appears to be deterioration at the older ages. I'll explain reasons for those trends and future expectations.

The Society of Actuaries released the 1990-95 Basic Mortality Tables in April 2000. In 2001, they released the Valuation Basic Tables (VBT), which are the tables that will be loaded to become the 2001 CSO. The 2001 CSO will replace 1980 CSO. The biggest difference between the VBT and 1990-95 is that 1990-95 is an experience table that emphasizes fit over smoothness. For the VBT, the objective was to make a much smoother table that can be used for valuation purposes. We'll see some other differences as well.

Let's consider the ratios of 1990-95 to 1975-80 male mortality rates for issue ages 25, 45, and 65, and durations 1-15. At issue age 45, duration 1, the ratio starts out at 59 percent, which shows that there has been significant improvement for that issue age and duration. Over time the ratio increases to 82 percent at duration 10

and declines to 75 percent at duration 15. I did some present values. For issue age 45 the present value over 15 years is 74.7 percent. That is almost 2 percent per year on an average annualized basis. For age 25, however, the ratio again starts out at duration 1 with improvement, but it goes up very, very quickly, and, in fact, the ratio is above 100 percent at durations 8-15. Since this is experience from 1990-95, it includes experience from before there was AIDS testing and blood testing. The experience reflected in 1975-80 was before the AIDS epidemic, so there were no reported deaths from AIDS in the 1975-80 data. For issue age 65, the ratio starts around 66 percent at duration 1 and grades up to 95 percent at duration 15. So, there is much more improvement in the early durations compared to the later durations.

How do you take this information with different ratios for each issue age and duration and put it into something that you can use? I did get it all on one graph (Chart 1). It is a little complicated. But you can think of it like a topographical map. On the bottom, the x-axis, is issue age 18-70. Duration is on the y-axis, 1-15.

For males, there are improvements in mortality at all issue ages and durations, with the exception of those ages 18-27, and durations 6-15. Improvements in health care in conjunction with better underwriting drove reductions in mortality. Death from heart disease and stroke have been reduced through better diagnostics and therapies, for example, drug treatment for hypertension. In the 1980s, when blood testing was used more at lower ages and face amounts, underwriters found that there was even more benefit from doing the blood testing. They found that we could look at cholesterol. Looking at different things can be useful in searching out other diseases as well. Smoking and the effects of smoking cessation significantly impact mortality. With more use of blood testing in underwriting, we found ways to carve out risks that would be better than standard and used those criteria to develop preferred risk classes.

I then graphed a comparison of 2001 VBT to 1975-80 mortality (Chart 2). For issue age 25, VBT mortality is capped at 80-85 percent of 1975-80 mortality, to eliminate the impact of AIDS. Going forward, we do not expect to see AIDS deaths to the same extent in the insured business because we select out those at risk for HIV through underwriting. VBT has a steeper slope than 1975-80. Early durations are showing the greatest improvement. Again, a lot of that is due to the more restrictive underwriting that we've seen. To summarize for males, the AIDS impact was removed. We saw the most improvement at the middle ages primarily due to the improvement in access to health care and the treatments that are now available for those ages, especially for heart disease. New drugs for hypertension and new drugs to lower cholesterol also play a role. The least improvement was seen at the older issue ages.

Let's now consider females. At issue age 45, the ratio of SOA 1990-95 to 1975-80 mortality rates starts out low, 52 percent at duration 1, and increases to 87 percent at duration 15. The ratio of the present values over 15 years is 81.5 percent,

versus 74.7 percent for males. Thus, the improvement at the middle ages has not been as great for the females as it has for the males. What is going on at issue age 65? When compared to 1975-80, it's almost always greater than 100 percent. The ratio of the present values is 112.7 percent over 15 years. We do apparently see that there is deterioration going on at these older ages compared to 1975-80. Showing the ratios for issue ages 18-70 and durations 1-15 combined into one graph, a much smaller peak is evident for issue ages 24-28, durations 9-10. AIDS did affect females but not quite as significantly. The main problem is for issue ages 60 and older. When compared to 1975-80, the ratios are almost all greater than 100 percent. That is what we really want to try to investigate.

The same driving forces behind the improvements in males, such as expanded health care choices and new drugs, are also seen in females. However, the results have had more effect on males than females. Next, I want to postulate the reasons for the deterioration at those older ages. We definitely need to understand this and why it's important.

The reason it's important to be looking at female mortality at the older ages is because there are more females exposed to risk than males. I looked at the exposure of our business by age and sex. About 20 percent of our business is female for issue ages under 55. For issue ages 65-69 exposure is about a third females. For issue ages 70-plus, females are greater than 50 percent of the business. So, it's a cohort that you want to pay attention to, especially if you're underwriting or pricing the older ages.

What is causing this adverse trend in female experience at the older ages? The reasons I'm going to talk about are improved risk selection, compositional changes, higher socioeconomic status, postponement of mortality, and smoking behavior. Improved risk selection reduces the number of deaths, so that's going to improve mortality. Over the last 25 years there have been significant strides in underwriting. Underwriters are much more knowledgeable about the risk factors and their impact on mortality. As I mentioned earlier, the lowering of the blood testing limits in the 1980s was a catalyst to a lot of this information. Since then, we've developed lots of new and improved tools and screens that have helped to evolve risk selection. Along with this, we've introduced preferred risk criteria that are much more restrictive. With preferred risk products, the more restrictive underwriting will drive lower mortality experience in the earlier durations, which will end up steepening the slope.

Let's talk about the compositional changes. The SOA 1975-80 experience was the first time that females were studied separately in terms of mortality. In the SOA 1965-70 tables, there was an age setback that was used for females. So 1975-80 was the first time that we started looking at females separately. When you think about the type of woman that bought insurance in the 1960s and 1970s compared to the women that were buying insurance in the 1980s and 1990s, there's been a demographic shift. There's been a big growth in the female market during recent

time and much more heterogeneity in the insured population. So, what I suggest is that some of the changes are due to a compositional effect where you have a different group of women buying insurance now than you did back then. That could be causing some of what we're seeing. So, in fact, it's not that what we're seeing would be wrong, it's just that what we have now would be more credible and in terms of comparing it to 1975-80, more valuable.

Now for some market considerations. These are some quotes from Life Insurance Marketing and Research Association's (LIMRA) *Market Facts Quarterly*, spring 2001, "Women are more independent and self-sufficient than at any time in history. Gen X women are marrying later than baby boomers. Almost half of the babies born in the U.S. were born to single women. The largest increase in motherhood is among white college-educated women where they do this by choice, not by chance." Here's another interesting statistic. For widows, the average age at a spouse's death is 56 years old. That's a surprisingly young age. Throughout this presentation we've been talking about how women continue to live longer than men, although the gap is closing. I think these last two points really demonstrate a woman's need for financial security and shows that there is a marketplace out there for financial products for women.

Here's some additional thoughts. Women really do control the purse strings. Women write 80 percent of all the checks. They're responsible for 85 percent of all consumer spending. The prototypical client of the life insurance industry used to be a white male, affluent, married with children under age 18. That type of household has now been surpassed by households headed by a female with no spouse present and nonfamily households headed by females. So, the number of households headed by females is now greater than the traditional households that one would typically think of as the typical client that was marketed in the past for insurance. Eighty-one percent of women with spouses make or share equally in the savings and investment decisions.

Socioeconomic status is also generally associated with mortality. The higher the socioeconomic status, the lower the mortality. That's typically measured in terms of income and education. We've seen an increase in both over the last 30 years. First we've seen many more degrees conferred on women when comparing the 1990s and the 1970s. There has also been a dramatic increase in female age-specific labor force participation. In 1970 most women dropped out of the labor force in order to have children. Even in the 1980s there was still somewhat of that effect occurring. In the 1990s, it appears that women no longer drop out of the labor force to have children. Over 75 percent of women between the ages of 25 and 55 were in the labor force. That's a big difference between the 1990s and the 1970s.

You would think that women working more would actually increase their mortality because they're becoming more like men (more stressed out, etc.). But, in fact, that's not the case. Increasing their labor force participation does increase survival. That is typically related to things like a better standard of living. Women have more

money when they're working, so there's less financial stress. They have improved access to health care. A lot of times companies will have wellness programs or health clubs at their place of employment. These benefits tend to outweigh the workplace stress, and also the increased exposure to occupational hazards.

Another fact about women is the increase in women-owned businesses. There are 9.1 million in the U.S. Women run all sizes of businesses. They own nearly 40 percent of all U.S. businesses and generate over \$3.6 trillion in revenue. They create 1 in 4 jobs, which is more than the *Fortune* 500 combined.

Another potential reason why we would see that female mortality could be worse at the older ages is that there is a postponement of mortality happening. Deaths that previously occurred to women at younger ages are now occurring later than before. This could be due to better treatment of certain conditions, such as early detection by breast cancer screening and PAP smears that reduce cancer deaths at younger ages. Women will die when they're older. This could also explain why there's more improvement at the younger ages and some deterioration at the older ages.

Changes in smoking behavior are very important. This is probably the most important reason for why mortality appears to be getting so much worse at the older ages. The effect of smoking on female mortality lags 25 years behind the smoking impact on male mortality. In 1964, when the surgeon general came out with its report, it was based on data from men. Smoking was already an epidemic for men. In 1980, the surgeon general came out with another report. It stated: "the first signs of an epidemic of smoking-related disease among women are now appearing." That was 25 years later for women than for men. Prevalence of smoking for men has decreased a lot faster than prevalence for women. There is still a significant number of women smoking. The 2001 surgeon general's report on smoking and women says that we're in the midst of a full-blown epidemic. Since 1980, three million women have died prematurely from smoking-related diseases. Lung cancer is now the leading cause of cancer death among U.S. women, surpassing breast cancer in 1987.

Women who were born between 1931 and 1940 had about a 45 percent prevalence rate of smoking. That is the highest of any birth cohort. What I believe may be contributing to the higher mortality is that it could be a cohort effect, just like what we saw with men and AIDS. It could be that the women born in the 1920s and 1930s with the highest prevalence rates and who turned 60 and older in 1992 are the cohort with higher mortality experience. For women in this cohort, whether they are current smokers or former smokers, they're going to have a lot higher mortality than any other cohort.

Let's talk a bit about the future of female mortality. There's an increasing emphasis on women's health studies and clinical research that focuses solely on women. In 1990, Congress introduced the Women's Health Equity Act, and there were 22 bills; some passed. With more focus on women's research, a better understanding of

what to do will emerge. The impact of smoking will continue to have an effect for some years from now. I also believe that future improvement in mortality will continue for the same reasons. The things that are already set in place, such as better health care through new and improved treatments and drugs, will continue to improve mortality.

The life insurance industry right now is well positioned to analyze and predict female insured mortality better than we've ever been before. We understand it and can leverage the knowledge to meet the specific financial needs and desires of women. We've seen that women are very much a presence, with their financial influence in households ever increasing. So we need to tap into this "high potential, yet underserved" market with new products and services.

In summary, there was improvement in female insured mortality at the younger ages, while there were some increases in mortality at the older ages. Is this deterioration a worsening mortality trend? Is it a postponement of death to later ages? If so, then the VBT is a good approximation of mortality. Is the deterioration a cohort effect related to smoking? I think there's a very good chance that this is the case. If it is the case, then the VBT may not be accurate going forward. Take good care when you're analyzing and interpreting mortality studies and understand the trends so that you know how to adjust the past results for your future work.

MR. BERGSTROM: I wanted to make a comment about one of the things that Mary was talking about with the 1975-80 tables. I study mortality quite a bit. In fact, that's what I mainly do now. I don't disagree that the 1990-95 tables, because of the fair amount of experience that we had in putting them together, does appear to show a deterioration of female mortality at the older ages. One of the questions that we haven't really seriously asked ourselves, though is, was our expected table correct in the first place? Back in 1975-80 we had really very little older-age female mortality. So the committee group that put together the table did some extrapolations. My question is, could it also be, at least in part, that the deterioration shows because the expected table was simply too low? I don't know the answer to that.

For those of you who study mortality improvement and different cohorts and ages and genders, etc., you need to also not overlook the fact that the word improvement is basically arithmetical averaging of some deterioration and improvement. So, if you're looking forward or if you're trying to decide if something is going to be a linear extrapolation, that may not be the best solution. Maybe what you need to do is look to the future. What are people dying of? What are the changes in death rates based on these causes? We may have some deterioration, for sure, but if we have more improvement, the sum total is going to be an improvement. That's where we need to focus on more than just our actuarial extrapolations.

FROM THE FLOOR: I was quite interested in one thing that you had mentioned and another thing that I've read. You had the testosterone spike which you attributed to suicide, homicide, and accidents. Is there something behavioral or something we could underwrite in order to identify males that exhibit this behavior more?

MS. KALBEN: It probably is related to behavior, but how much that behavior is related to hormones is where it gets a little bit difficult to separate.

FROM THE FLOOR: I think you used the term sex roles. Could it be related to that?

MS. KALBEN: It certainly could. The problem is that it's difficult to study that. You can't take half the males that are born and half the females and split them and raise half as males and half as females and see when they die. So, it's difficult to study that.

MS. HART: From an underwriting perspective, if you look at the accident rate and some of the things that happen in males in that period of time, I think underwriting has done a good job in using the motor vehicle report as a real basic kind of screening for that type of risky behavior taking. If you had sense, you'd order the motor vehicle report between the ages of 18 and 25 because that's where, again, the testosterone kicks in.

MS. KALBEN: That reminded me of something. Certainly with auto insurance they look at grades, keeping a B-average. I don't know if there could be a correlation there.

FROM THE FLOOR: There was a study by Trowbridge that measured the mortality effects of divorce and marriage, and the effect was consistent in that marriage was good for both males and females. The death of a spouse was negative, but it seemed to be much larger for males than females.

MS. KALBEN: Right. I do talk about that in the monograph, and I've got some more current data in addition to citing Trowbridge. Certainly there's lowered mortality for both sexes when they're married. It does look like the differential is greater for male, but it looks like that effect is lessening, lesser now than it had been.

MR. DAVID J. HIPPEN: It takes about 20 years or more before state legislatures are willing to allow the use of a new mortality table for valuation. We're in the process of discussing whether the 2001 CSO should be based on the mortality data that's been presented, and it's proposed to extend up through age 120. My question is it's really easy in pricing to make adjustments based on current data and to figure out that something was there that we don't know about, that cohorts matter, that smoking is suddenly making a big difference. What would you suggest

that we do to solve this problem that we don't change reserve bases more than once every 20 years?

MS. HART: Get more data.

MR. HIPPEN: Well, we're going to get a lot more data from ages 80-120 in the next 20 years, but we probably won't be able to use it for reserves unless we solve the problem.

MS. BROESCH: I think that what we're seeing in place today is giving more judgment to appointed actuaries in setting reserves. I encourage the Society to consider doing that more, just like what we've done with XXX and having X factors and giving the appointed actuaries the authority to test the appropriateness of those X factors in the reserves. We can potentially bring in more judgment that would allow more customization for an individual company with respect to reserves. That's not what we were trying to talk about here, but I think bringing more flexibility in that way would certainly help. Just like you were saying with the data, if we had more data and were able to turn around the information that we have quicker, then we could probably get that into the process sooner, and get up to date more quickly.

MR. BERGSTROM: I think part of our valuation problem in the U.S. has always been that we have this archaic net level premium approach as opposed to using a GAAP approach or what some other countries do. That really puts a crimp on what we can design as products. There's no question that people today live past age 100, and yet right now they would outlive their policies. We'd have to cash them in. My suggestion would be to allow more freedom to go up to a higher age than 100, be it 115 or 120. I don't really have a feeling on it yet. Because actuaries, by their profession, are required to look at the reserves, and if they feel they are undervalued for whatever reason, then they cannot necessarily use the minimums that are allowed by the state.

MS. BARBARA J. LAUTZENHEISER: I'm the vice-president of the Life Section of the Academy of Actuaries. I just wanted to make a couple of points that I made in an earlier session. The current 2001 CSO table is being designed for the current valuation system as it stands, but we are going to be moving toward reviewing within the Academy the various kinds of margins or ways in which we can develop company experience and the utilization of company experience. We've also taken a specific position having to do with movement toward utilization or non-formulaic bases for reserving so that we can utilize that company experience and move to something that does, in fact, involve more actuarial judgment over time. I would also say that I think that we, with both the Society of Actuaries and the American Academy of Actuaries, just need to pay attention to the fact that we can't let another 21 years go by before doing it. I started out in XXX over 10 years ago. We said that we had to develop XXX because it was going to take too long to do another table, and then we promptly didn't do one. So, we need to do it. We need

to pay attention to it. We need to move further. But we also need to move toward the nonformulaic bases, actuarial judgment, and company experience for mortality for a multitude of reasons. One of the reasons is that there are just so many preferred underwriting risks and different markets that people write in, that you can't possibly think in terms of just one mortality table. This concept of the valuation actuary, basic reserves, utilization of risk-based capital on top of that, and the Actuarial Opinion and Memorandum Regulation to make sure that those reserves are accurate to the company or adequate to the company is absolutely important.

MS. HART: The contributions that each company gives to the Society in order to accumulate this data are so important. The more information we have, the better our results. Really delve toward research and development, if you've got a background in that like I do, you realize the importance of using that data for the good of the whole.

Chart 1

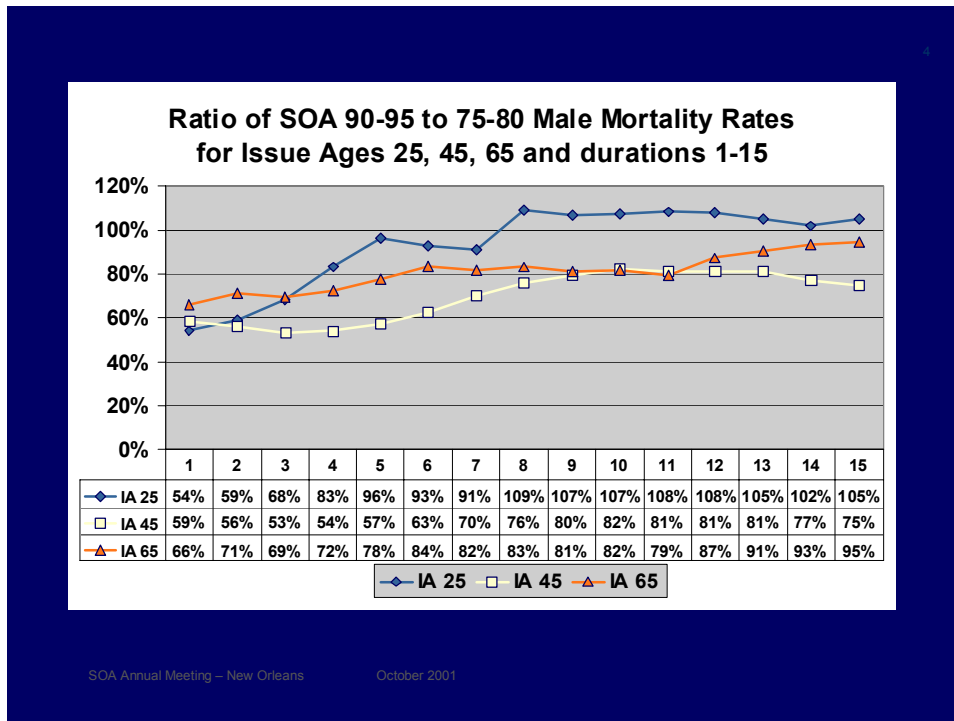


Chart 2

