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NEW BUILD AND BLOOD PRESSURE STUDY—A PREVIEW

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MR. COURTLAND C. SMITH: This session will present some provisional findings of the new Build and Blood Pressure Study. We hope to have the final results published under the joint auspices of the Society of Actuaries and the Association of Life Insurance Medical Directors in two volumes sometime in 1979.

MR. EDWARD A. LEW: Studies of morality among insured lives according to variations in weight date back to the Specialized Mortality Investigation published in 1918, the Supplement to the Medical Impairment Study 1931, the Build and Blood Pressure Study 1959, and the current study.

Studies of mortality among insured lives according to variations in blood pressure began with the Blood Pressure Study 1925, followed by the Medical Impairment Study 1929, the Blood Pressure Study 1933 and its supplement, the Build and Blood Pressure Study 1959, and the present study.

The current study is the first large scale intercompany mortality investigation made from computer tapes of individual policy records. The availability of sophisticated electronic equipment permits a review of all the information in the present study in about 7 hours, whereas a similar operation in the Build and Blood Pressure Study 1959 would have required about four weeks of machine time.

New kinds of actuarial planning and new computer procedures had to be devised for the current study. Credit for much of this effort goes to Mr. John Avery, Mr. William McDonald and Mr. Michael Rich. I want to take the opportunity to express my profound appreciation of their work on behalf of the Committee on the New Build and Blood Pressure Study.

Mr. Avery, formerly with the Recording and Statistical Corporation, but now on the staff of the Medical Information Bureau, had Mr. McDonald's assistance in preparing the computer tabulations, while Mr. Rich, Associate Actuary of John Hancock, took care of the necessary actuarial planning and calculations.

In so far as the current study's findings on build are concerned, we are fortunate to be able for the first time to compare the experience among insured lives according to build with the corresponding figures for a large sample of the general population. This latter experience derives from the American Cancer Society's Cancer Prevention Study. Begun in 1959, it traced for some 12 years about 750,000 men and women, initially free of heart disease, related impairments, cancer, and marked loss of weight. The results of this study according to variations in weight closely matched the findings

* Mr. Lew was not present but did submit a paper which was read by Mr. Smith.

**Dr. McCue, not a member of the Society, is Senior Vice President and Medical Director of the Life Insurance Company of Virginia.

for overweight men in the Build and Blood Pressure Study 1959, and for underweight men the findings in the current study. The findings for overweight women in the Cancer Prevention Study indicate somewhat higher mortality according to variations in weight than in the Build and Blood Pressure Study 1959 or the present study.

Although we are not in position to compare the experience of insured lives according to variations in blood pressure with corresponding findings for a large sample of the general population, we can do this for a number of special investigations based on relatively small and selected populations, such as the Framingham Study. The experience of insured lives with respect to blood pressure is in broad accord with these special studies, as well as with the figures in the final report of the Pooling Project Research Group which undertook to combine the results of the more important Special Studies.

The Build and Blood Pressure Study 1959, and the current study comprise together a unique body of information regarding the mortality of insured lives according to variations in weight and blood pressure. Such information does not extend much beyond weights in excess of 50 percent above average nor to blood pressures in excess of 175/105. It is invaluable, however, for life insurance companies in their underwriting and calculation of premium rates for substandard risks. The new study is also of great importance for public health in dealing with the common problems of the moderately obese and of borderline hypertensives.

With these considerations in mind we can more intellegently examine the highlights of the provisional findings of the New Build and Blood Pressure Study. I would stress that the figures about to be cited are still provisional, inasmuch as the painstaking job of carefully checking and reviewing all the computer printouts and conducting various subsidiary inquiries is not yet finished.

The principal findings of the current investigation appear to be as follows:

1. As shown in table 1, the average weights of men in the new study exceed the corresponding weights in the Build and Blood Pressure Study 1959 by 2 to 8 lbs. in the thirties, and by up to 5 lbs in the fifties, with the smallest difference for short men and the largest difference for tall men. Men in their early twenties have recorded average weights in the present study that are from 4 to 15 lbs. greater than the corresponding weights in the earlier study. The average weights of women in the current study have decreased by a pound or two in the thirties and by 2 to 7 lbs. in the fifties as compared with the earlier study, but the average weights of women in their early twenties have increased by 3 to 5 lbs.

2. As shown in table 2 the mortality ratios of overweight men, classified by ranges of absolute weight, are not significantly different in the new study from those in the earlier study.

3. As shown in table 3 men markedly overweight - that is those 30 to 60 percent above average weight - experienced lower mortality in the current study than in the Build and Blood Pressure Study 1959;

TABLE 1

AVERAGE WEIGHTS

NEW STUDY COMPARED WITH BUILD AND BLOOD PRESSURE STUDY 1959 AND ACS STUDY

	Ages 30 - 39			Ages 50 - 59		
	New Study	BBP 1959	ACS Study	New Study	BBP Study	ACS Study
Men						
5'3"	143 lbs.	141 lbs.	143 lbs.	145 lbs.	145 lbs.	145 lbs.
5'6"	156	153	154	159	157	157
5'9"	170	165	167	173	170	168
6'0"	184	179	179	187	185	182
6'3"	201	193	196	204	199	198
Women						
4'10"	113 lbs.	115 lbs.		121 lbs.	125 lbs.	
5'1"	121	123	122 lbs.	131	133	131 lbs.
5'4"	131	132	131	141	144	141
5'7"	141	142	141	152	156	152
5'10"	153	154	155	162	169	166

"ACS" refers to American Cancer Society Study.
"BBP" refers to the 1959 Build and Blood Pressure Study.

TABLE 2

MORTALITY EXPERIENCE BY ABSOLUTE WEIGHT

NEW STUDY COMPARED WITH BUILD AND BLOOD PRESSURE STUDY 1959

Range of Weights	Short Men		Medium Men		Tall Men	
	Avg. Wt. 150 lbs.		Avg. Wt. 170 lbs.		Avg. Wt. 190 lbs.	
	New Study	BBP 1959	New Study	BBP 1959	New Study	BBP 1959
	Mortality Ratios in Relation to Standard Experience					
105 - 114 lbs.	120%	110%	115%	113%		
125 - 134	105	96	110*	89	107%	94%
145 - 154	102	95	99	90	99	82
165 - 174	108	113	96	100	91	90
185 - 194	120*	125	109	113	100	94
205 - 214	145	139*	125	125	110	114
225 - 234			149*	144*	135*	130*
245 - 254					155	

"Short Men" are 5'3" to 5'6"
"Medium Men" are 5'7" to 5'10"
"Tall Men" are 5'11" to 6'2"

*Graduated mortality ratio

TABLE 3

MORTALITY EXPERIENCE BY DEPARTURE FROM AVERAGE WEIGHT

New Study Compared with B & BP 1959 and ACS Studies

Departure from Average Weight	Men			Women		
	New Study	BBP 1959	ACS Study	New Study	BBP 1959	ACS Study
	Mortality Ratios in Relation to Standard Experience					
20% below	105%	90%	110%	110%	99%	100%
10% below	94	95	100	97	95	95
10% above	111	113	107	106	109	108
20% above	120	125	121	110	121	123
30% above	133	142	137	125	130	138
40% above	150	167	162	136		162
50% above	171	200	210	150*		200
60% above	195*	260				

*Graduated mortality ratio

their mortality ratios in the new study are from 10 to 65 percentage points lower, the differentials increasing with mounting overweight. The mortality ratios of overweight women, classified by percentage departure from average weight, exhibit somewhat smaller decreases from the earlier study.

4. By way of contrast, men weighing 20 percent below average recorded 10 to 15 percent higher mortality in the new study than in the Build and Blood Pressure Study 1959, as is indicated in table 3. The optimum weights for men in the new study appear to be those about 10 percent below average weight. Women weighing 20 percent below average registered about 10 percent higher mortality; their optimum weights also seem to lie about 10 percent below average weight.

5. Mortality of overweight women is relatively lower than that of overweight men, the differentials ranging from 10 percentage points for weights 20 percent above average to about 20 percentage points for weights 50 percent above average, as is shown in table 3.

6. Table 4 presents the highlights of mortality by cause among overweight men. Men weighing 20 percent above average experienced mortality from all causes in the new study that was 20 percent above standard (equal to 100 percent). Their death rates from coronary disease were about 15 percent higher, and their death rates from digestive diseases 20 percent higher. Men weighing 40 percent above average recorded mortality from all causes approximately 50 percent greater than standard (equal to 100 percent). Their death rates from coronary disease and from cerebral hemmorrhage were about 60 percent higher, their death rates from diabetes more than 400 percent higher, and their death rates from digestive disease about 120 percent higher.

7. As shown in table 5, average systolic and diastolic pressures for men were generally fractionally lower than in the earlier study. Women's average systolic pressures were significantly lower in the new study, while their average diastolic pressures were only slightly lower.

8. Mortality of men with elevated systolic and diastolic pressures, shown in table 6, was appreciably lower than in the earlier study; the mortality ratios in the new study are about 10 percentage points lower for systolic pressures about 135 mm and about 30 percentage points lower for systolic pressures about 160 mm. The corresponding differentials for diastolic pressures are about 10 percentage points for diastolic pressures about 85 mm and 30 percentage points lower for diastolic pressures of 100 mm.

9. As shown in table 6 mortality of women with moderately elevated systolic and diastolic pressures was not significantly different from that in the earlier study; however, the mortality ratios for women with systolic pressures over 160 mm and diastolic pressures over 100 mm were distinctly lower in the new study.

10. Mortality of women with elevated systolic pressures was materially lower than that of men at corresponding systolic levels.

TABLE 4

MORTALITY EXPERIENCE BY CAUSE OF DEATH AND WEIGHT FOR MEN

New Study Compared with ACS Study — Mortality Ratios in relation to standard experience by cause

Cause of Death	Weights 20% below	Weights 10% below	Weights 10% above	Weights 20% above	Weights 30% above	Weights 40% above	Weights 50% above
Coronary Disease							
New Study		73%	102%	113%	138%	163%	180%
ACS	89%	95	112	128	144	175	
Cerebral Hemorrhage							
New Study	103	89	92	103	128	155	
ACS	115	105	108	116	135	191	
Cancer							
New Study	103	89	83	95	100	105	120
ACS	123	106	101	105	112	124	
Diabetes							
New Study		62	120	240	475		
ACS	86	92	133	210	300		
Digestive Diseases							
New Study	88	83	101	120	145	220	
ACS	134	114	122	168	238	344	
All Causes							
New Study	105	94	111	120	133	150	171
ACS	110	100	107	121	137	162	210

TABLE 5

AVERAGE SYSTOLIC AND DIASTOLIC PRESSURES

New Study Compared with Build and Blood Pressure 1959 and U.S. 1971 - 1974

	SYSTOLIC			DIASTOLIC		
Age Range	New Study	BBP 1959	US 1971-74	New Study	BBP 1959	US 1971-74
Men						
15 - 19	117.0	117.3	120.0	70.0	71.3	72.0
20 - 29	121.8	121.4	124.4	74.0	74.2	75.6
30 - 39	123.0	122.9	126.1	76.1	76.3	79.6
40 - 49	125.0	125.5	130.8	77.8	78.2	83.3
50 - 59	128.4	129.1	137.1	79.0	79.5	85.6
60 - 69	132.0	132.4	142.8	79.3	79.6	85.8
Women						
15 - 19	112.8	114.1	114.0	69.8	70.0	71.0
20 - 29	115.0	116.2	116.0	71.4	72.1	73.0
30 - 39	117.5	119.2	119.4	73.6	74.5	77.0
40 - 49	121.9	124.9	126.9	76.3	77.5	81.0
50 - 59	126.6	130.2	137.0	78.5	79.8	84.4
60 - 69	131.8	133.8	147.3	79.6	80.1	85.8

TABLE 6

MORTALITY EXPERIENCE BY SYSTOLIC AND DIASTOLIC PRESSURES

New Study Compared with Build and Blood Pressure Study 1959

Systolic Pressure								
	88-97m	98-127m	128-137m	138-147m	148-157m	158-167m	168-177m	178-192m
Men								
New Study	70%	85%	111%	136%	168%	210%	224%	232%
BBP 1959	78	88	118	155	194	244		
Women								
New Study	92	91	108	122	135	167		
BBP 1959		90	105	122	140	230		

Diastolic Pressure						
	48-67m	68-82m	83-87m	88-92m	93-97m	98-102m
Men						
New Study	84%	94%	119%	138%	171%	204%
BBP 1959	83	97	129	150	188	234
Women						
New Study	87	97	115	133	163	183
BBP 1959	93	95	108	122	168	218

Mortality of women with elevated diastolic pressures was only slightly lower than that of men at corresponding diastolic levels.

11. The presence of minor impairments alongside of blood pressures in excess of 150/90 usually produced significant increases in mortality, as is indicated in table 7.

12. Table 8 presents the highlights of mortality by cause of death among hypertensive men. Men with blood pressures in the range 138/83 to 147/92 experienced mortality from all causes in the new study that was 41 percent above standard (equal to 100 percent). Their death rates from coronary disease were 51 percent higher, from cerebral hemorrhage 62 percent higher, from hypertensive heart disease 136 percent higher, and from nephritis 21 percent higher. Men with blood pressure in the range 148/93 to 167/97 exhibited mortality from all causes approximatley 100 percent above standard (equal to 100 percent). Their death rates from coronary disease were almost 150 percent higher, from cerebral hemorrhage nearly 250 percent higher, from hypertensive heart disease over 300 percent higher, and from nephritis approximately 20 percent higher.

13. The new study included two separate investigations of treated hypertensives. The combined results indicate that men whose blood pressures after treatment fell below 150/100 registered mortality in the standard range, based on 135 deaths; those whose blood pressures after treatment exceeded 150/100 recorded mortality approximately 160 percent of standard, based on 52 deaths. Even though these findings relate to highly selected risks free of other serious impairments, the figures indicate a mortality improvement among treated hypertensives extending over a much longer period of time than that reported in clinical studies.

14. Mortality among both overweights and hypertensives rises more rapidly with successive increments of weight and blood pressure than would be the case if a linear increase were operative, except that those grossly overweight and those with very high blood pressure exhibit a flattening of the mortality curve.

In comparing the results of the new study with those of the Build and Blood Pressure Study 1959, it is essential to take into account those differences in circumstances which may have tended to produce lower mortality among overweights and hypertensives in the new study. The following differences deserve special attention:

1. The period 1935 - 54 covered by the Build and Blood Pressure Study 1959 was on the whole characterized by a steady rise in the death rate from coronary heart disease, while the period 1954 - 73 covered by the new study saw the beginning, in the early 1960's, of a pronounced decline in coronary heart disease mortality. This downtrend operated to lower the mortality of both overweights and hypertensives in the new study. During the time covered by the new study, more effective hypertensive treatment came to be generally used, dietary restrictions grew increasingly popular, and other changes in middle class life styles were widely adopted. The decline in coronary artery disease mortality and its implications are the subject of a special conference by the National Institutes of Health in Bethesda, Maryland to be held October 24-25, 1978.

TABLE 7

MORTALITY EXPERIENCE BY BLOOD PRESSURE - QUALIFYING FACTORS

New Study Compared with Build and Blood Pressure Study 1959

Men Untreated or Treatment Unknown

Blood Pressure Groups	Below 118/73	128/78 to 138/87	138/87 to 147/92	148/87 to 158/92	148/93 to 167/97	168/93 to 177/102
Without Minor Impairments						
New Study	76%	112%	142%	172%	193%	219%
BBP '59		112	148			237
With Minor Impairments						
New Study	87	114	139	196	221	282
BBP '59		130	169			231
With Over Weight						
New Study	79	116	142	169	187	223
BBP '59			201		217	296
With Albuminuria						
New Study	91	156	172	202	222	
BBP '59			175		229	

TABLE 8

MORTALITY EXPERIENCE BY CAUSE - MEN - BLOOD PRESSURE

New Study Compared with Build and Blood Pressure Study 1959

Cause of Death	Below 118/73	128/78 to 137/87	138/83 to 147/92	148/88 to 157/92	148/93 to 167/97	158/93 to 177/102
Coronary Disease						
New Study	50%	105%	151%	197%	237%	159%
BBP '59		118	161			240
Cerebral Hemmorhage						
New Study	45	105	162	213	340	421
BBP '59		138	231			587
Hypertensive Heart Disease						
New Study	73	192	236	402	412	358
Nephritis						
New Study	47	124	121	194	123	350
BBP '59		130	260			450
Digestive Diseases						
New Study	54	111	139	167	237	257
BBP '59		113	142			184
All Causes						
New Study	76	112	141	172	201	233
BBP '59		112	153			232

2. Five large north-eastern companies contributed more than half the experience in the Build and Blood Pressure Study 1959, but these same companies accounted for only about a quarter of the experience in the new study. On the other hand, several companies which have customarily catered more to the carriage trade made up nearly half the experience in the new study, but only about a quarter in the earlier study. This change in the composition of the population of insured lives under study toward higher socio-economic levels could operate to lower the mortality in the new study. The new study also includes a sizeable proportion of the post-depression generation, the male portion of which is an inch taller and about 10 lbs. heavier on the average, probably reflecting higher standards of nutrition.

3. Methods of risk selection have become increasingly effective since the close of the Build and Blood Pressure Study 1959. Greater use of electro-cardiograms and blood chemistry tests would have tended to eliminate the worst risks among overweights and hypertensives from the experience in the new study.

4. The study includes a rather high proportion of exposures at the early durations, because a sizeable number of companies contributed data beginning only with the issues of 1960. This had the effect of understating the mortality for all durations combined among marked overweights (but not among severe hypertensives), and of overstating the mortality of pronounced underweights. For example, preliminary tests indicate that the mortality ratio for men 50 percent overweight was thereby understated by 6 percentage points and the mortality ratio for men 60 percent overweight was understated by perhaps as much as 36 percentage points; contrariwise the mortality ratio for men 20 percent underweight was overstated by about $3\frac{1}{2}$ percentage points.

Before the final report is written, the effect of the qualifications outlined above will be carefully explored, and differences in the experience between individual companies given due weight in drawing conclusions.

HOWARD McCUE MD.: Hypertension has intrigued medical scientists for 60 to 70 years. Obesity has been obvious for much longer than that. Neither condition is sharply defined, but is judged on the basis of variation from an established norm. From a medical view point obesity is less well understood than hypertension--which places it in quite an obscure category.

The etiology of obesity remains vague. There are various theories involving hypertrophy vs. hyperplasia of adipose cells, mode of caloric intake, energy expenditure etc., but we are basically reduced to the principle that most people long in positive caloric balance gain weight or maintain an obese state.

The role of obesity as a unique and independent risk factor in cardiovascular morbidity and mortality has varied from one study to another. Some confusion exists as to the exact significance of this factor. The well established relationship of obesity with hypertension, with abnormal serum lipids, and with diabetes immediately raises its level of importance, for in association with these disorders, particularly hypertension, it becomes a potent risk factor.

The 1979 study shows that men are heavier at all ages than in the 1959 study. This is more marked at the younger ages. It should be noted that men are also taller. Women are heavier only at the younger ages, and they are no taller. Mortality tends to increase progressively with increasing degrees of overweight, but compared to the 1959 study excess mortality is appreciably less in the more markedly obese (30-60% overwight men and 30% overweight women). There seems no ready explanation for this except the decline in over-all cardiovascular mortality that began in the 60's and accelerated over 1969. The general population is quite diet conscious and older women seem to be making some progress. Obesity is more important as a risk factor with advancing age. It is notable that older men are not much heavier than their comparables in the 1959 study and the older women are actually lighter. In addition mortality associated with obesity is so strongly related to other conditions, particularly cardiovascular, that changes in death rates due to coronary disease or hypertension have a major impact.

A generation or more ago, the emphasis in hypertension was on etiology. Considerable data has been accumulated, but the fundamental etiology escapes us. Secondary hypertension (that secondary to a known cause) accounts for less than 10% of the total, probably less than 5%. Sir George Pickering, after a life time investigating hypertension concludes that it is a disorder in which the deviation from the norm is quantitative and not qualitative. Our mortality studies certainly support this view. Elevated blood pressure is a manifestation of disordered physiology not a specific diagnostic finding. There is no sharp point of differentiation between normotensive and hypertensive populations, but a gradually increasing incidence of morbidity and mortality as the quantitative level of blood pressure rises. Independent studies show that either the systolic or diastolic determination may be used as an index; over-all the systolic level seems the more sensitive.

During the period of this current study (1954-1973) long term prospective studies of general population samples have accumulated knowledge of the morbidity and mortality associated with obesity and hypertension. Some of these are the Framingham Study, Tecumseh Michigan study and others in Chicago and Buffalo, etc. 15 to 20 years follow up shows remarkable agreement among these groups. There is an approximately linear relationship between mortality and initial systolic and diastolic blood pressure. This confirms observations of the 1959 Build and Blood Pressure Study and the 1979 study as well. In the current study mortality increases disproportionately with rising blood pressure levels so there is not a straight line correlation. Clinical medicine has also recognized this fact and may have over-emphasized it to the detriment of those persons with mild to moderate elevation of blood pressure who were not regarded as needing active treatment.

Treatment has assumed a major role in the last 6 to 10 years. Important

new drugs have contributed to increasingly favorable results. The oral diuretic, chlorothiazide, was a major step in 1956. There were drugs available prior to that date, but most had some unsatisfactory feature. Alpha methyldopa (Aldomet) appeared in 1960 and propranolol in 1970. The Veteran's Administration Cooperative Study on the efficacy of anti-hypertensive treatment further popularized the use of these and other drugs following the reports given in 1968 and 1970--particularly in cases of moderate elevation of blood pressure.

The role of therapy in control of hypertension is limited by several factors. First a substantial portion of hypertensives are unaware of their problem. Second a relatively small proportion are under treatment, and continued compliance is not good. The National Center for Health Statistics, conducting surveys on probability samples of the entire U.S. populations, has produced some very revealing information. In the 1960-1962 sample 23% of those with elevated blood pressure reported drug treatment. In the 1970-1974 sample the number was 24%. Continuation of therapy is not consistent; even well educated and upper social class patients stop their medication. After one year only 20-30% of patients are still taking their medication. The National High Blood Pressure Education Program begun in 1972 has resulted in widespread publicity aimed at the general population and the health professions. Hopefully this will improve subsequent results. There is reason to believe this occurring. Analysis of sale of antihypertensive drugs showed a major upswing in 1973 and 1974. The number of visits to physicians for hypertension followed this same pattern.

For whatever reason the 1979 study shows improved mortality for hypertension. Average blood pressure readings are not remarkably different from the 1959 study, fractionally lower for men and distinctly lower for women. Mortality ratios are lower for men at all levels, not significantly different for women at the lower levels, and lower for women at the higher levels of blood pressure. As expected the reasons for this improvement are not glaringly obvious. There are certain logical considerations. An insurance population is a selected group: predominantly middle class, economically self-sufficient, actively employed and predominantly men. This group should have ready access to medical care as well as other benefits (to mortality) of higher socio-economic status. They are certainly the group most likely to have received treatment in the 1960's, and therein lies a major point. Much of the extra mortality from hypertension, particularly in the selected period, comes from those at the upper end of the spectrum of blood pressure levels. These were more likely to be placed on treatment, to be carefully followed, and to obtain the greatest benefit. Our data consists largely of front end observation and cannot tell the follow-up story. Many must have had subsequent drug therapy. If 25% did the impact would be enormous. Based on very limited sample the current study shows remarkable results if the blood pressure can be controlled to the 140-160/90-95 range. At this level the treated hypertensive shows materially lower mortality than the subject with the same level of blood pressure whose treatment status is unknown. There is logical explanation for this. This group has demonstrated that treatment is effective in control of blood pressure--not true of all hypertensives. Treated hypertensives whose blood pressure persists in the higher range show very high mortality. These are treatment failures. Additionally the selection process tends to weed our many of those with target organ damage--primarily those with abnormal electrocardiograms. This has resulted in a further selected group which should improve mortality.

In summary we know that elevated blood pressure is a consistent and strong contributor to the risk of coronary artery disease and cerebral vascular disease. Numerous studies have shown that treatment can substantially reduce the risk of and mortality from stroke. The picture for coronary artery disease is less clear, but one must believe that it is improved. The small treatment sample in the 1979 study seems to substantiate this. I have always felt that the life insurance industry studies provide the most meaningful statistics available on build and blood pressure. I still do. This is primarily due to our contributions regarding mortality associated with hypertension, a condition having the following notable features:

1. It is common.

2. It tends to progress.

3. Complications after the passage of time are often serious.

4. Mortality is increased exponentially as level of blood pressure rises.

5. Adequate treatment can lower blood pressure in a high percentage of cases with substantial reduction of morbidity and mortality.

Hypertension is probably the major cardiovascular public health problem. Our contribution has been considerable, but as Henry Blackburn so aptly stated, "Recent progress in the study of epidemiology has resulted not in a classical review of the evidence but rather in intellectual excitement, questions and controversies." Many questions remain unanswered and we must pursue them further.

MR. MICHAEL J. RICH: The previous presentations concentrated on two very important aspects of the study, that being, the results and their implications from an underwriting and medical viewpoint. However, as actuaries we realize that there is another aspect which at times can be of equal importance, the methodology used to develop the results. The methodology is important for two reasons. First, comparisons of the numerical results from this study and the 1959 study are only meaningful in light of any differences used in the development of the two sets of numbers. Secondly, several unique approaches were used in this study which should be of special interest to all of us.

The comparison of the results of this Study with the one in 1959 is inevitable. For that reason, it was very important to begin planning for the new study on the same basis of tabulation as the 1959 Study on every point except those which we felt could be improved upon. One of the major improvements occurred in the original collection of data. For those of you who have been involved in intercompany studies, you are aware that it has been the practice to have the contributing companies verify and summarize the data in a predefinded format and submit the data on computer cards for compiling. The lack of flexibility in analyzing data submitted in this way is obvious. Since we are supposed to be in the computer age, and we had access to the computer facilities and systems experts at the Center for Medico-Actuarial Statistics, we chose to break tradition and collect the data from the 25 contributing companies by individual record on computer tape.

Besides the flexibility, this approach allowed for improved homogeneity since the same validity criteria and same exposure formulas were applied to all the records. It also allowed greatly expanded freedom in testing of any of the assumptions before they were applied. The obvious disadvantage of this approach is the computer systems problem of processing the approximately 5 million records we had collected. To give you an indication of the enormity of this file, it takes approximately 7 hours to make a pass of all the records. Despite this drawback, I personally feel that this approach for studies such as these will be used more often in the future.

When an Actuary talks about mortality statistics, the subject quickly turns to mortality ratios. However, mortality ratios are only meaningful if a proper mortality basis is used for calculating expected deaths. The basis which is commonly used in other impairment studies, and was used in the 1959 Study, is to develop mortality tables from the data submitted to the Society of Actuaries' Annual Study of "Mortality under Standard Ordianry Insurance Issues" for the appropriate issue and exposure years. It was our intention to use this same approach for this Study. After developing mortality tables by this method, we took advantage of the flexibility I mentioned previously, and tested these tables derived from recent issues against the standard issues submitted by the contributing companies. These tests proved that these tables were not adequate for our purposes. The tests of goodness of fit showed that the early duration mortality rates were too high, while the overall mortality rates proved to be too low when measured by number of policies. There are several reasons why we feel that the tables derived from recent issue experience proved inadequate. The major reasons are:

1) Although 15 of the 25 companies which contributed to this Study also contributed tc the Society's annual study, the percentage contribution by each company varied greatly between the two studies.

2) The exposure period of almost 20 years involved a period characterized by dramatic mortality changes. The distribution of exposure by issue year can have a major impact on the final mortality rates.

3) This last point may also account for the reason that mortality rates based on amount of insurance, which would weight recent experience more heavily, would be inappropriate for mortality ratios by number of policies.

4) In general, the Society's annual study exposure data are based on year end valuation files, whereas, in this study the exposure was calculated on a seriatim basis.

It should be understood that basic tables are developed from recent issues simply because they represent a convenient approximation. It does not necessarily follow that these tables are an appropriate yardstick for special studies, as we found out with this set of circumstances. Therefore, the method we employed to develop the basic tables was to use the standard experience actually contributed to this Study. Separate tables were calculated and graduated for males and females, by number of policies and amount of insurance. The resulting mortality rates were approximately 20% lower than those used in the 1959 Study. This change in methodology should not be considered as a compromise, but rather as an improvement when it comes to interpreting the results.

Once it was determined that the standard issues in the Study would be used to develop the basic tables, it automatically followed that the same data should be used to develop the expected deaths for the cause of death analyses. The cause of death distributions from this experience was compared with independent data to make sure they were reasonable.

The next major problem that we faced was how to combine the standard and substandard experience in the final results. The reason this problem arises is that companies prepare data for these types of intercompany impairment studies by manually coding cases using selected samples. It is this sampling design which creates the problem since different companies code different percentages of standard and substandard cases. It was our initial intention to weight the data for each individual record based on the percentage of standard and substandard cases actually coded by each company Although this may seem to be the most accurate approach, we felt there were dangers in giving undue significance to deaths contributed by companies that had coded very small samples. The solution we chose was to use the same weighting factors for all the data regardless of which company actually contributed the data. After thorough analysis of the data, it was determined that an appropriate weighting would be 4 to 1, standard to substandard. Although not intended, this was the same weighting factor as used in the 1959 Study.

It is not uncommon when comparing two studies, such as this one and the one in 1959, that differences arise that have the potential to distort meaningful comparisons. In our case the distribution of exposure fell into this category. The extent of this difference can be seen by the fact that the 1959 Study had approximately 1/3 of its data in the first five exposure years, whereas this Study had about 1/2 of its data in the same period. As long as we compare mortality ratios by duration, no problem exists. However, when comparing overall mortality ratios there is the potential for distortions. This factor would be most significant where there is a sharp, well-defined increase or decrease in the mortality ratios by duration, as often occurs at either the extreme build or blood pressure categories.

Despite the fact that we collected some 5 million records, there were still three areas in which we felt there was inadequate data and required special supplemental studies. The first involved identifying deaths due to coronary artery disease, which is a very significant cause in the study of hypertension and overweight. The particular cause of death involved in each death record was identified according to the Society of Actuaries' cause of death codes from either 1950, 1961, or 1970. Although the 1961 codes identified deaths due to coronary artery disease, this was not true of the other two sets of codes.

Therefore, we had to go back to all the contributing companies with a list of deaths which could have possibly been due to coronary artery disease to get further details. This approach did not prove as successful as you might expect due to the common practice of companies to destroy death records around seven years after the claim is paid. The last two areas which required supplementary data involved items which were known to be scarce in the 1959 Study. These two areas are the effect of treatment on hypertension and the impact of extreme blood pressure readings. In order to obtain additional data on the effect of treatment on hypertension, we tapped the MIB files for cases which had been reported to MIB with treated hypertension. These cases were sent to the reporting companies so detailed information could be recorded on those which were actually issued and paid for.

We were able to collect data on about 4,000 cases; however, this data did suffer from a very short exposure period due to the fact that the MIB files are only retained for 7 years. The additional data on the extreme blood pressure required a different approach. Since many companies code 100% of their substandard cases, we felt we had collected the majority of the issued cases with extreme blood pressures from the contributing companies. Therefore, it was thought that the only untapped source of additional data was those cases originally declined due to high blood pressure. Four large contributors were approached and asked to review their files to select cases declined with blood pressures of 160/100 or over where other policies had previously been issued. This latter condition was obviously necessary to allow status to be traced. This data is unlike the main body of data in the Study since these cases may have major impairments other than either build and/or blood pressure.

I would like to conclude this presentation with a few general comments about these types of studies and what can be done by each company to improve them in the future. The two areas of particular concern are wider participation and maintenance of files. Although we collected some 5 million records from 25 companies, we would have liked to have had an even broader representation. The variations in markets and underwriting standards among companies makes broad representation imperative. It is impractical to expect companies to be able to make any significant contribution unless they are willing to code cases as they are issued and paid for. Once files are established, file maintenance becomes a critical issue. One of the major delays we had in this study was caused by the lengthy period we had to wait while companies brought their files up to date. This should not be interpreted as criticism of the contributing companies, because without their effort, no study could have been done. However, we did run across companies who had spent a great deal to establish files, but the files were so hopelessly outdated as to be useless. Both of these points have in common the need of additional committment. Although the committment may seem great, it should be viewed in light of the amount of money your company currently spends on placing applicants in the proper rating classes, and the role these studies play in that function. From this viewpoint, the price tag may not be as high as it may first appear.

MR. SMITH: The improvements in relative mortality of overweights and hypertensives seem to reflect favorable developments in medicine and underwriting. The diagnosis and treatment of coronary artery disease, hypertension and heart abnormalities have improved. The use of the electrocardiogram and similar diagnostic tools has become almost routine in the assessment of large-amount risks.

The slight worsening of mortality for underweights is an interesting finding. The substandard portion of the experience shows fairly high mortality ratios for underweight and average weight. This is probably due to a high proportion of cases with other impairments among underweights and a high proportion of cases with minor cardio-vascular impairments and/or borderline hypertension among average weights. The standard portion of the experience,which predominates, shows slightly increased mortality ratios. My guess is that most underwriters in the contributing companies have tended to discount minor impairments in the presence of underweight, and that some underweights had latent neoplasms or diabetes at issue. However, a few underwriters - especially in recent years - have begun taking a more critical stand on hypertension and minor CVR impairments in the absence of overweight and these underwriters have managed to make their substandard rating stick.

While underweight mortality is up, I doubt that many underwriters will feel that this justifies an increase in ratings for underweight itself. For one thing, the underwriting problem is not underweight,but what the underweight may signify regarding underlying physiological process in the presence of other medical impairments. For another, the most difficult underwriting problem of all is to attempt to increase ratings.

Anthihypertensive therapy appears to work. For reported levels of blood pressure below 150/100, cases under treatment showed somewhatlower mortality ratios than those with unknown treatment. Unfortunately, the reported blood pressures at issue may have been the average pressures used in assigning ratings - averages obtained by combining current and pre-treatment readings. The true current readings were probably lower for many treated cases. Thus the comparison with cases having unknown treatment may be somewhat misleading: treatment works but probably isn't as effective as our figures indicate.

Conclusion

The main finding of the New Build and Blood Pressure Study is somewhat reduced mortality for overweights and appreciable lower mortality for hypertensives. Please note, however, that very marked overweights (60% over average weight) and marked hypertensives (about 160/95) still show roughly 200% mortality.

In recent years overweight and hypertension ratings have been liberalized. I would guess that liberal underwriters will feel that their ratings are already lower than the experience ratios of the new study, but that their own experience will prove even better. However, conservative underwriters may well feel that further liberalizations in ratings are in order. Thus, I would expect the recent downtrend in build and blood pressure ratings to continue, but perhaps at a slower pace.