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The Build and Blood Pressure Study

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MR. LEW pointed out the extended period of time which had elapsed since earlier studies of build and blood pressure, and reviewed the scope of the present investigation. In terms of exposures, the build study is more than six times as large as the Medico-Actuarial Mortality Investigation and about twelve times as large as the build study covered by the Supplement to the Medical Impairment Study; the blood pressure study is about five times the size of the 1939 Blood Pressure Study. Women comprise about one-fifth of the exposures in the present investigation. Substandard risks account for $7\frac{1}{2}$ percent of the exposures in the build study and 4 percent in the blood pressure study. By resorting to stratified sampling, it proved possible to derive reliable average weights and blood pressures as well as their distributions, making use of only about half as many individual cases as had been used in M.I.S. 1929.

In his opinion the more important findings of the study are:

1. New tables of average weights which differ significantly from the tables now in use.
2. Data on the prevalence of overweight, underweight, and elevated blood pressure.
3. Optimum weights which are somewhat lower than those developed in earlier studies.
4. Decreased mortality among underweights but substantially the same relative mortality among overweights compared to earlier studies.
5. Evidence that reduction in weight results in at least a temporary decrease in mortality.
6. Average blood pressures not materially different from those recorded in the 1930's.
7. Much higher mortality ratios for slight and moderate elevations in blood

pressure, thus more than confirming the previously questioned finding in the 1939 Blood Pressure Study of increased mortality on small elevations.

8. Much higher mortality than expected for combinations of overweight and elevated blood pressure, or combinations of either with certain related impairments.
9. Additional evidence that a family history of early cardiovascular-renal disease is associated with a substantial increase in mortality, especially when found in combination with overweight or elevated blood pressure.
10. Distinctly lower mortality among women than men, particularly among those with slight or moderate departures from average weights or blood pressures.

Emphasis was placed on several characteristics of the 1959 Build and Blood Pressure Study which should be kept in mind in interpreting the results:

1. All mortality ratios are based on the Basic Table 1935-54, which represents much lower death rates than those of the earlier basic tables. Consequently, where the current mortality ratios are about the same as in earlier studies, they reflect much lower absolute mortality rates; even where current ratios are materially higher, as in the case of slight and moderate elevations in blood pressure, they usually reflect lower absolute mortality rates.
2. During the period covered by the study, mortality among standard male risks was approximately 105 percent of the Basic Table 1935-54, while mortality among standard female risks averaged about 60 percent, ranging from about 75 percent in the twenties to about 50 percent past age fifty. When relating experience on male and female lives to their own average mortality on standard risks, the mortality ratios presented in the study must be adjusted accordingly.
3. The experience by cause of death reflects the increased dominance of diseases of the heart and circulatory system as causes of death, not only among standard risks but particularly among overweights and persons with elevated blood pressure. In general, significantly high mortality from other causes shows up only in broad groupings of the experience.
4. Careful selection had a marked effect on the experience. This is most evident in the experience on extreme overweights and high blood pressures, as well as in the experience with favorable electrocardiograms which reflects, in part, the careful underwriting of policies for large amounts. This experience will not be duplicated in the future unless comparable selection standards are maintained. To a lesser degree this also applies to the experience on persons in their sixties and on very tall persons.
5. The experience reflects the conditions prevailing from 1935 through 1954. The lives issued during this period include a substantial proportion of wage earners and hence also of the later immigrant stocks, who were less well represented in earlier studies. The experience also reflects the popular acceptance of dieting, the vogue of slenderness among women, the prevailing

attitudes and practices of medical examiners in recording blood pressures, and the preparation for the taking of blood pressure on the part of some applicants. The more effective hypotensive drugs recently developed, however, were not widely used before 1954.

He reviewed the results with regard to average height and weight, prevalence of overweight and underweight, optimum weights, and the mortality experience. It is significant that while only 6 percent of all men and 11 percent of all women currently weigh 20 percent or more above average, nearly 40 percent of all men and women weigh 20 percent or more above their optimum weight, i.e., the weight where the lowest mortality ratios are obtained. The penalties of being overweight can be emphasized by pointing out that men weighing 20 pounds above average experience mortality about 10 percent higher than men of average weight but 25 percent higher than men of optimum weight. Similarly, men weighing 35 pounds above average experience 25 percent higher mortality than men of average weight but 40 percent higher than men of optimum weight. Men who weigh 50 pounds above average experience up to 75 percent higher mortality or about 100 percent more than men of optimum weight. In general, mortality ratios among overweights are not materially different from those found in the M.A.M.I. and the Supplement to the M.I.S. While excess mortality is due largely to diseases of the cardiovascular system and diabetes, caution is indicated in underwriting overweights with gall bladder and related digestive disorders. The experience on underweight men was favorable, but underwriting caution is also required at the older ages where cancer begins to take a heavy toll.

He also pointed to the sizable body of data on combinations of overweight with elevated blood pressure and overweight and albuminuria on which the excess mortality is clearly very much higher than the sum of the excessive mortality associated with each of these impairments. The high mortality found among men with family histories of early cardiovascular-renal disease, analyzed according to variations in build, confirms the findings on this impairment in the 1951 Impairment Study.

In a general review of the blood pressure experience, he pointed out that the average readings have changed little since the 1939 study; for males, the average systolic pressure is well represented by the formula of 111 mm. plus one-third of the age. In commenting on the reliability of readings he emphasized that sixteen of the twenty-three contributing companies ignored past readings in determining the blood pressures reported for purposes of the study.

The most startling finding is the high mortality among men with slight or moderate elevations in blood pressure. In his opinion, the degree

to which the true blood pressures may have been understated on life insurance applications, either because of the attitude of examining physicians or because applicants prepared themselves for the examination, did not appreciably affect the validity of the results, although the probable effect should not be disregarded in interpreting the experience for slight and moderate elevations in blood pressure.

In conclusion, only some of the findings of the 1959 Build and Blood Pressure Study provide unequivocal answers to questions concerning the mortality associated with variations in build and blood pressure. Some of the unexpected results are susceptible to different interpretations. In adapting these results for their own use, companies will have to take into account their own practices; the second volume of the study will include helpful details. The problem of setting ratings for build appears to be relatively simple. On the other hand this will be a troublesome process for elevated blood pressures; some supplementary studies, particularly of the experience on cases with multiple readings and on cases with past readings of elevated blood pressure, may be needed.

MR. NOVEMBER discussed the findings with regard to elevations in blood pressure, primarily in men (Tables 53 through 59 in the study). He reasoned that the experience with no known minor impairments was a proper point of departure in setting ratings. Comparison of this experience with the basic table, which is derived from experience on individuals both with and without minor impairments, results in an understatement of the mortality ratios by about 6 percent; on the other hand, there is an offsetting 5 percent overstatement in the male mortality ratios since the basic table includes experience on both male and female lives.

Aside from the higher level of mortality ratios now found for slight or moderate elevations in blood pressure, the general characteristics of the 1939 Blood Pressure Study are largely repeated. The mortality ratios increase as the systolic and diastolic readings increase, both separately and jointly on an additive basis. For a given reading, the highest mortality ratios occur at ages 30 to 50, with a definite drop after age 50. The best mortality results were obtained at below average readings.

In commenting on the unexpected results for the groups with slight to moderate elevations, he felt that this might be explained partially by the fact that because the basic table has a higher proportion of deaths resulting from cardiovascular disease than older basic tables, an impairment with heart conditions as an important cause of death will throw off higher mortality ratios.

The fact that mortality ratios in general did not increase with duration was another surprising finding.

In an effort to determine whether systolic or diastolic readings had the greater effect on the mortality ratios for a given percentage departure from normal, he defined the normal systolic group to be that with readings of 98 to 127 and the normal diastolic as 68 to 82. At ages 30 and up, a given percentage increase in the systolic reading results in a greater increase in the mortality ratio than an increase of the same degree in the diastolic reading. Under 30, the converse was true.

He also found that the mortality ratios tended to increase more rapidly with rising systolic readings than did mortality ratios associated with similar percentage departures of diastolic readings from the average.

Attempting to answer the question as to when substandard risks are first encountered, he pointed out that when the systolic is less than 128, mortality ratios are generally under 130 percent, and when the systolic exceeded 137, the ratios are generally higher than 130 percent. Between 128 and 137 systolic, the ratios exceeded 130 percent when associated with higher diastolics but not when associated with low diastolics. The diastolic experience does not lend itself to the same kind of generalization.

In order to compare male and female experience, the male experience should be related to male expected mortality and the female experience to female expected mortality. To make such a comparison he divided the male mortality ratios by 1.05 and the female mortality ratios by .50 to .60 depending on age. For given systolic readings, women had only slightly lower ratios than men; for given diastolic readings, the mortality ratios were more definitely lower than for men.

While acknowledging that changes in underwriting attitude toward some minor impairments were justified by medical developments, MR. MORTON raised the question of the continuity of coding standards for minor impairments during the exposure period of the study. MR. JAMES E. HOSKINS observed that if minor impairments were improperly ignored in recent years, the mortality ratios for the "without known minor impairment" groups are higher than they otherwise would have been. MR. LEW said that in the process of consulting with the companies in an effort to set a uniform schedule for coding minor impairments for the study, the committee had discovered that there were a great many conditions considered to be minor impairments in the late 1930's but now disregarded, *e.g.*, many gall bladder disorders, rapid pulse, and nervousness. While there are probably only a small proportion of such cases, the results are undoubtedly affected. MR. NOVEMBER, commenting on the impact of minor impairments on the blood pressure experience, emphasized that the two "minor" impairments which seem to have the greatest effect on the mortality ratios (family history of

cardiovascular-renal disease and albuminuria) may not be "minor" at all since the 1951 Impairment Study revealed such high mortality ratios for standard policies with these impairments alone. He suggested that the presence of a minor impairment requires selective care rather than severe underwriting treatment in all cases.

DR. HUTCHINSON, speaking from the medical man's point of view, noted that there is now definite statistical support for the principle that underweight is not an impairment but in fact desirable. In the past, underweight was frequently an expression of underlying but undetected tuberculosis. Also very tall people were at one time thought to be impaired risks; this is not the case provided an abnormal cause, such as glandular disease, can be ruled out.

The development of ideal weight tables will help nutrition experts and people interested in public health. If this information is made available to doctors and the public and popularized, further improvement in the basic mortality table may be expected in the future. The evidence that reduction in weight results in lower mortality should add impetus to the giving and following of advice to lose weight.

Other facilities in the medical field are conducting experimental and statistical studies trying to pinpoint the relationship of diet, exercise, racial and family background, and somatic type to atherosclerotic changes in blood vessels. How the factors work is unknown, but the 1959 Build and Blood Pressure Study again confirms that build plays a definite role in the incidence of cardiovascular disease.

The gradual change in average blood pressure with advancing age is much less than many clinicians would indicate on the basis of their experience, and many feel that a faster rate of increase is within normal limits. The average doctor is not impressed by small variations in blood pressure, and he does not think of the blood pressure cuff as a precision instrument.

The blood pressure cuff in constricting the individual's arm does more than simply measure blood pressure. The initial constriction may be overcoming muscle tone in the individual, and it is very difficult to get an accurate measurement compared to pressures recorded by a cannula in the artery. Again, in the case of an individual with a labile blood pressure, the physician will record a figure in round numbers which is as accurate as necessary from his point of view. If accurate figures are desired, the request for the readings required must be specific.

There has been an unfortunate association in the minds of most people that a substandard rating for life insurance is synonymous with a need

for medical attention. Doctors know the effect of alarm on blood pressure, and it is difficult to apply substandard underwriting concepts where the practicing physicians are not in sympathy.

He felt that there will be increased use of antihypertensive drugs by applicants for insurance. While the effect of these drugs on mortality is unknown, it is speculative to assume that the mortality experience will improve in direct proportion to the lowering of blood pressure. The development of a test to detect the presence of these drugs is desirable, and the insurance industry should take an active part in this; there is no reason why clinicians need such a test.

MR. WEBSTER stated that apparently the underwriting of build alone based on existing build tables has been reasonably accurate, and the favorable results from underweights and tall overweights have probably already been anticipated by changes in the present ratings. Perhaps the practice on applicants who have reduced their weight and, in view of the results by duration, the practice of granting credits for Endowments should be reviewed. Unfortunately variations in mortality among overweights by chest and waist measurements were not studied, and the girth credits or debits are an important factor in borderline cases.

A new build table for females is obviously needed. The present rule of adding one inch and using the male table does not conform to the female experience. For males the present table with minor adjustments is probably satisfactory. The important section is "Build with Minor Impairments" (particularly build with slight hypertension), where apparently the underwriting has not kept pace with the experience for either men or women. The minimizing of minor impairments can be costly.

On blood pressure a general conclusion that this impairment is being underrated is not justified without careful review. The underwriting practices of the contributing companies and the way in which the blood pressures were reported could affect the results. The possibility of past histories of abnormal blood pressure having been ignored (as stated on page 37 of the *Study*) could well have increased the mortality ratios. There is plenty of evidence existing prior to the present Study of the dangers of such a practice.

The experience on blood pressure with minor impairments duplicates that of the Build Study. Two sections, "Build with Ratable Blood Pressure" and "Blood Pressure with Ratable Build," are significant, and the result emphasizes the importance of these two impairments. The favorable experience on "Entrants with Favorable Electrocardiogram" should not mislead the underwriter. This was most probably an experience on

strictly selected risks. As a contrast, high initial mortality as shown by the duration tables (particularly in the age 15-39 group) might be due to liberal selection.

Present ratings for blood pressure and present methods of arriving at the blood pressure readings for rating have to be reviewed and a separate blood pressure table for women is probably necessary. Future underwriting of blood pressure is extremely difficult because of the expanded use of tranquilizers which can conceal the true blood pressure. Even where treatment is admitted the resultant mortality is still a guess. In translating the experience into ratings, not only must the various warnings on interpretation be heeded but the individual company's practice and scale of extra premiums must also be taken into account. Extra premiums based on multiples of the 1941 CSO Table have a built-in factor for increases in the actual to expected mortality ratio.

In general the results suggest that the effect of minor impairments on mortality has been ignored and that this change in practice has proven expensive in many instances.

MR. ROBERT J. JOHANSEN, who supervised the assembly of data and computational work of the 1959 Build and Blood Pressure Study by the Central Bureau of the Committee on Mortality under Ordinary Insurances and Annuities, observed that the size of the 1959 Build and Blood Pressure Study (over six million punch cards) demanded a mass production approach using high speed computers. However, large numbers of small errors in individual company contributions made necessary a great deal of additional hand work with resulting increases in both time and cost. He said that the experience of the Central Bureau in compiling the 1959 Build and Blood Pressure Study pointed up the need for an improvement in both the quality and the control of data submitted to intercompany studies. In particular, he urged that companies be requested to furnish control totals on exposures and expected deaths, not merely on actual deaths as in the 1959 Build and Blood Pressure Study. He emphasized that his remarks were intended only to call attention to the need for accuracy and were not meant as criticism of any past performance. He felt sure that none of the discrepancies mentioned were large enough to affect any conclusions that might be drawn from the study.

In discussing the difficulties encountered, he said that, for example, extensive errors were found to have occurred in the minor summary cards, all ages by duration and all durations by age. Unfortunately, it was not until after the material from all companies had been merged and summarized that it was found that individual cells did not add to subtotals

and the subtotals did not add to totals because of errors in the subtotal cards of some contributions. This greatly increased the clerical work of the Central Bureau. In some instances, portions of an individual company's contribution were obviously miscoded or unusable for other reasons and were therefore omitted from the main tabulations.

The most troublesome errors were those in the cause of death study. Each company contributed a card for each policy death in their experience, and these cards were controlled to the main study by study code, age group, and duration group. In many cases the total of individual death cards from a company did not agree with the corresponding summary card. Only after an enormous amount of hand work was it possible to account for differences and match the death cards to reported totals.

As indicated on page 6 of the 1959 Build and Blood Pressure Study, some of the contributing companies were unable to include all the years of issue or all of the calendar years of experience which had been requested. Fortunately, special tests showed that the various contributions tended to complement each other, and consequently the Basic Table 1935-54 was a satisfactory measure of expected mortality. As a solution for future studies, he suggested that each company be provided its own basic table based on intercompany experience but covering precisely the issue years and experience years which the company expects to include in its contributions. A single basic table would be obtained for publication by summarizing the exposures and expected deaths in the contributions of the various companies and dividing the totals. This procedure would ensure a basic table matching precisely the data contributed.

Companies contributing to the study were asked to enter the insured's name and date of birth on each card, and he suggested that this be discontinued in the future. To obtain the number of lives in all cases would, judging from experience with the 1951 Impairment Study, have meant a considerable increase in cost. For classes with very large numbers of deaths, it is unnecessary to obtain the numbers of lives involved; where the numbers of policy deaths are very small, the numbers of lives are not particularly helpful due to the sizable chance of fluctuations. In this study the numbers of lives were obtained only where needed to explain mortality ratios which appeared to be out of line but where the numbers of policies were large enough to make chance fluctuations an unlikely cause. In the future, companies should not be asked to provide identification on policies until after the experience has been compiled and reviewed, and then only where needed to evaluate the results.

Dr. NORMAN J. BARKER (Connecticut General Life Insurance Company) commented that there is not a great deal which is new re-

vealed in the study. The pressure to change underwriting rules in the face of over-all mortality improvement and competition has been too much for most underwriting departments, and the study does provide strong support for a return to more realistic underwriting. He suggested that more frequent studies based on an evaluation of individual cases in accordance with agreed upon criteria and independent of the action or philosophy of the contributors would be very helpful.

In response to a question, MR. NOVEMBER said he felt that the favorable results found for a diastolic 25 percent above average in combination with an average systolic were more likely due to chance fluctuations than conservative underwriting, since the groups were small. In general, however, a variation in the systolic reading had greater effect on the mortality ratios than the same percentage change in the diastolic reading, and he felt that future research to uncover the reasons for this might be profitable.

DR. M. HENRY CLIFFORD (Union Central Life Insurance Company) recalled a study of about 500 patients in the hypertensive clinic at the Presbyterian Columbia Center in New York presented by Dr. George Perera. The main thesis was that hypertension is not a disease until it becomes accelerated, the acceleration of the rate of increase being what is important clinically; also that diastolic of above 90, regardless of how high or low the systolic might be, was a more important clue of shortened longevity than other factors. MR. LEW added that they have begun a study of the employees of the Metropolitan Life Insurance Company along the same lines; thus far the evidence indicates that a distinction must be made between elevated blood pressures which remain relatively stable and those which rise sharply, the latter producing poorer mortality experience.

MR. BURTON E. BURTON reported that the Aetna Life Insurance Company had recently completed a study of the effect of the time of day on blood pressure. Comparing the results with the 1959 Build and Blood Pressure Study, they reached the conclusion that time of day had no real effect. MR. LEW pointed out that clinical and public health studies show that the initial reading is frequently higher than subsequent readings, and DR. HUTCHINSON added that the blood pressure level of people who work under pressure frequently rises by the end of the day. DR. JAMES R. GUDGER (Mutual Life Insurance Company of New York) noted that a study of 2,500 cases from 1942 through 1953 revealed that the reading for individuals with a constant elevation produced the same mortality experience as the average of the readings, at the same level, for people with a labile blood pressure.

MR. DOUGLAS T. WEIR inquired as to the reasoning behind the selection of the build groupings used in Tables 23 through 25 which present the results for build by policy duration. Each covers approximately a 20-pound range so that each represents a progressively smaller departure from average weight as the weights increase. In the extreme, Group V covers persons as low as 124 percent of average weight (five feet eleven to six feet two at ages 50 to 59) and as high as 200 percent (four feet ten to five feet two at ages 20-29). While the degree of spread in Groups I through IV is not nearly so marked, Group V is heterogeneous, and the results should be interpreted with care. MR. LEW agreed that Group V covered a wide range but added that this was necessary to avoid too small numbers of deaths in certain categories.

DR. HUTCHINSON was asked if he thought that the publicity arising from this study would result in pressure on the medical profession to prescribe treatment, particularly at the younger ages where the study indicates a mortality of 150 percent. He replied that he doubted that treatment would be started at that level; the practicing physician has the advantage of asking his patient to return, and a future increase in the blood pressure level will probably be the determining factor in starting treatment. He felt that the study was not designed for direct clinical application.