

# Causes of Death in a Series of 4738 Finnish War Amputees

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THE loss of a limb and its replacement by a prosthesis create conditions deviating from the normal. Walking is always more difficult. Loon (2) found that the energy consumption of amputees increases with the level of amputation. In the case of an above-knee amputation the effort of walking is greater than in a below-knee amputation and, in cases of hemipelvectomy and disarticulation of the hip, energy requirements are still greater. In the same investigation, it was found that walking with crutches, without a prosthesis, requires more energy than walking with a prosthesis. In addition, it appeared that in the presence of disturbances in the stump that affect walking, the consumption of energy increases. A poorly fitted prosthesis has the same effect. During walking, the center of gravity should shift smoothly, not in a jerky way that makes it more difficult to maintain balance. Almost all amputees experience excessive sweating not only of the stump but in general. The tightly fitted socket and the thigh corset used in connection with the old, conventional type of below-knee prosthesis are contributory causes of sweating.

Owing to the loss of the weight and accompanying movements of the amputated limb, upper-extremity amputees find it more difficult to keep their balance in walking after amputation. Similarly, the strain on the remaining upper limb in lifting and carrying is greater than before. The increased consumption of energy taxes the circulation and the heart. In this connection, no further attention will be paid to the secondary changes in the weight-bearing structures, particu-

larly the joints and spine, that result from the altered static conditions due to the loss of a limb (9).

The health of amputees has been the subject of many previous studies, *e.g.*, those of Rausche (6), Schneider (7), Schulze (8), and Bodechtel (1). Meyer-ingh, Stefani, and Cimbal (5) reported a higher rate of hypertension in obese amputees than in amputees of average weight. In an electrocardiographic investigation of 1033 amputees, performed by the same authors, no differences were observed as compared with a normal series. Likewise, in a series of 1128 amputees obesity was not more frequent than in a corresponding group of the general population (5). Loos (3) reported similar findings in a series of 647 cases. Solonen, Rinne, Viikeri, and Karvinen (9) observed no noteworthy increase in cardiac and vascular diseases in amputees.

The purpose of this study was to find out whether death from degenerative cardiac and vascular diseases is more common among amputees than in the general population. At the same time tuberculosis, cancer, accidents, suicide, and miscellaneous causes of death were surveyed from the same standpoint.

## MATERIAL

The series consists of 4782 war amputees. Data was collected from the files of the State Insurance Department. Finger, hand, toe, and foot amputations have been omitted since these cause no major problems. Before the end of 1944, *i.e.*, during the war, 44 amputees died. These cases are also considered in this study. The age distribution in this group was the same as in the remaining 4738 cases which have been followed up from 1945 till the

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end of 1965. The causes of death were obtained from the death certificates. During the last 10 years a steadily increasing number of cases have been examined post-mortem. In case of a casualty, or when the cause of death is unknown, autopsy is invariably performed. As a rule, the autopsy records contain more than one diagnosis, but in this study only the main diagnoses have been utilized. Although many of the second diagnoses might have been of interest, taking them into account would have implied considerable technical problems and would have rendered the statistical treatment more difficult. Since 1945, 643 subjects have died. During the period 1940-1965 the total mortality was thus 687/4782 (14.4 per cent). The number of mortalities during each year is shown in Figure 1. A steady rise is seen from 1960 onward. This increased mortality is not surprising, considering that more than 20 years have elapsed since the war and the mean age of the war veterans is about 50. However, this curve

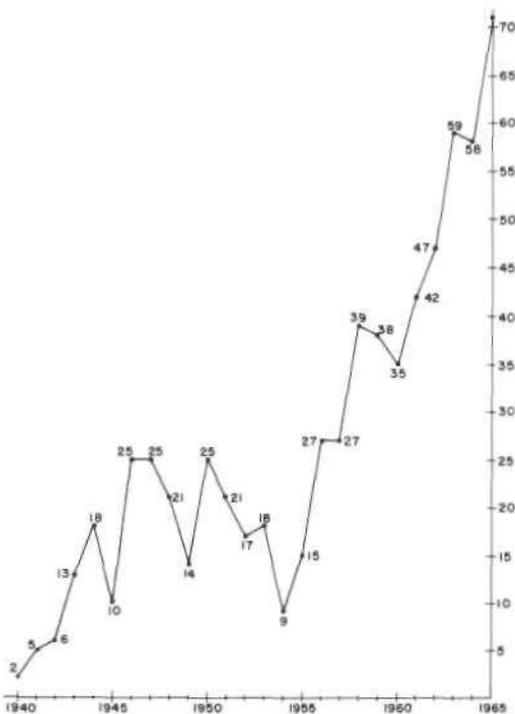


Fig. 1. Annual mortality of war amputees in 1940-1965.

alone permits no conclusions to be drawn. In order to form an opinion concerning the mortality of the war amputees, the figures have to be compared to the death rates for the corresponding age groups of the general population.

#### AGE AND OCCUPATION

For the main causes of death the distribution of the dead war amputees by 5-year age groups is given in Table 1. Mostly, the age groups 40-50 years show the highest mortality. However, for conclusions to be drawn concerning the health of the group under review, comparable data for a "normal" group is required. The occupations of the dead, differentiated mainly on the basis of training, are given in Table 2. In this connection the main interest attaches to the proportion of heavy laborers.

Farmers (177) and unskilled workers (230) constitute the largest groups. Heavy labor is represented by 72.6 per cent, light occupations by 27.4 per cent. The handicraftsmen number 74 (10.8 per cent). There are as many as 31 shoemakers, which is accounted for by the fact that training for this occupation was offered after the war.

#### LEVEL OF AMPUTATION

The level of amputation appears in Table 3. Finger, hand, toe, and foot amputations were not included in this series because the trouble caused by them is considered to be so slight that it cannot lead to vascular disease. Two amputees in the present series had Chopart stumps, one had a Pirogoff stump, and in six cases disarticulation of the wrist had been performed. The ratio of above-knee to below-knee amputations is 1:2.

#### METHOD OF COMPARISON

The age distribution of the series followed up, exclusive of those who died before 1945, and the percentage figures for the corresponding age groups of the general Finnish male population are shown in Table 4. As may be seen in the table, the age distribution of the am-

TABLE 1. DISTRIBUTION OF THE CAUSE OF DEATH BY 5-YEAR AGE GROUPS IN A SERIES OF 687 DEAD WAR AMPUTEES

| Age Group (years) | Degenerative Vascular Diseases of the Central Nervous System | Degenerative Cardiac and Vascular Diseases | Tuberculosis | Malignant Diseases | Injuries | Suicides | Other Diseases | Total |
|-------------------|--|--|--------------|--------------------|----------|----------|----------------|-------|
| 20-24             |  |  | 6            |                    | 1        | 4        |                | 11    |
| 25-29             |  | 2  | 18           | 1                  | 10       | 6        | 11             | 48    |
| 30-34             | 2  | 8  | 14           | 2                  | 13       | 5        | 9              | 53    |
| 35-39             | 5  | 14   | 13           | 7                  | 10       | 10       | 13             | 72    |
| 40-44             | 11   | 37   | 11           | 11                 | 13       | 19       | 29             | 131   |
| 45-49             | 13   | 56   | 6            | 25                 | 16       | 11       | 17             | 144   |
| 50-54             | 11   | 48   | 1            | 21                 | 5        | 5        | 8              | 99    |
| 55-59             | 12   | 33   |              | 18                 |          | 2        | 6              | 71    |
| 60-64             | 5  | 11   | 1            | 7                  | 4        | 1        | 3              | 32    |
| 65-69             | 3  | 6  |              | 2                  |          |          | 3              | 14    |
| 70-74             |  | 3  |              | 1                  |          |          | 1              | 5     |
| 75-79             | 2  |  |              | 1                  |          |          |                | 3     |
| 80-84             |  | 1  |              |                    |          |          | 3              | 4     |
| Total             | 64   | 219  | 70           | 96                 | 72       | 63       | 103            | 687   |

TABLE 2. DISTRIBUTION ACCORDING TO OCCUPATION

| Occupation              | Number | Per Cent |       |
|-------------------------|--------|----------|-------|
| University-educated     | 20     | 11.8     |       |
| School teacher          | 3      |          |       |
| Musician                | 1      |          |       |
| Technician              | 16     |          |       |
| Businessman             | 17     |          |       |
| Office clerk            | 13     |          |       |
| Store keeper            | 11     |          |       |
| Labor foreman           | 15     |          |       |
| Noncommissioned officer | 3      |          |       |
| Craftsman               | 9      |          |       |
| Optician, watchmaker    | 10     | 27.4     |       |
| Baker                   | 1      |          |       |
| Tailor                  | 1      |          |       |
| Shoemaker               | 31     |          |       |
| Painter                 | 3      |          |       |
| Carpenter               | 12     |          |       |
| Blacksmith              | 5      |          |       |
| Masseur                 | 2      |          |       |
| Chauffeur               | 15     |          |       |
| Gardener                | 2      |          |       |
| Farmer                  | 175    | 15.6     |       |
| Skilled worker          | 62     |          |       |
| Unskilled worker        | 230    |          |       |
| Sailor                  | 5      |          |       |
| Fisherman               | 6      |          |       |
| Doorkeeper              | 8      |          |       |
| Unknown occupation      | 11     |          |       |
| Total                   | 687    |          | 100.0 |

TABLE 3. CLASSIFICATION ACCORDING TO LEVEL OF AMPUTATION OF THOSE AMPUTEES WHO DIED DURING THE PERIOD 1945-1965

|                          |     |
|--------------------------|-----|
| Shoulder disarticulation | 3   |
| Above-elbow              | 96  |
| Below-elbow              | 63  |
| Wrist disarticulation    | 6   |
| Hip disarticulation      | 3   |
| Above-knee               | 193 |
| Knee disarticulation     | 1   |
| Below-knee               | 319 |
| Pirogoff                 | 1   |
| Chopart                  | 2   |
| Total                    | 687 |

TABLE 4. AGE DISTRIBUTION OF 4738 AMPUTEES AT THE BEGINNING OF 1945 COMPARED TO THE GENERAL FINNISH MALE POPULATION

| Age Group (years) | Number | Per Cent | General Male Population (per cent) |
|-------------------|--------|----------|------------------------------------|
| 15-19             | 200    | 31.2     | 16.0                               |
| 20-24             | 1275   |          |                                    |
| 25-29             | 1296   |          |                                    |
| 30-34             | 1034   | 67.0     | 27.0                               |
| 35-39             | 572    |          |                                    |
| 40-44             | 275    |          |                                    |
| 45-49             | 55     |          |                                    |
| 50-54             | 13     | 1.8      | 19.0                               |
| 55-59             | 12     |          |                                    |
| 60-64             | 6      |          |                                    |
| Total             | 4738   |          |                                    |

putees differs widely from the age distribution of the general Finnish male population as obtained from the Statistical Yearbook of Finland. For this reason, the death rates for the general Finnish male population could not be used as such for comparison with the mortality rate of amputees. It was necessary therefore to construct an equivalent, theoretical population with an age distribution corresponding to that of the amputees. The data required was obtained in part directly from the Statistical Yearbook, and in part by calculation based on the death rates for men and women and the sex ratio, or for the earlier years, on the total mortality and the age distribution of the dead, as indicated in the Statistical Yearbook. In the comparisons, it was deemed most appropriate to consider only the period from 1945 till the end of 1964. The amputees who died before 1945 numbered 44, and 71 died in 1965. When these 115 cases were subtracted from the total number of dead in the present series (687), 572 cases remained for the comparative analysis of mortality.

#### MORTALITY

As mentioned above, the total mortality for the period under review was 687/4782 (14.4 per cent). The causes of death are listed in detail in Table 5. The distribution according to the cause of death has been given in summary form in Table 1. Degenerative vascular diseases of the central nervous system and degenerative cardiac and vascular diseases have the same etiology but each forms a separate entity, and the Statistical Yearbook of Finland provides figures for comparison precisely on this basis. In addition, death rates were available for pulmonary tuberculosis, malignant diseases, accidents, and suicide, other causes falling into a miscellaneous group consisting of cases for which no comparative figures were found in the Statistical Yearbook. Many cases of poisoning and drowning were recorded under accidents. Alcohol abuse was a major etiological factor. It was sometimes

difficult to decide whether the cause of death was an accident or suicide.

#### COMPARISON OF MORTALITY OF THE AMPUTEES AND THE GENERAL POPULATION

In what follows, the total mortality is analyzed first and then the mortality in the various groups listed above is analyzed, except for the miscellaneous group for which no comparable data was available.

#### TOTAL MORTALITY

On comparing the total number of deaths during the period January 1, 1945, to December 31, 1964, *i.e.*, 572, to the mortality of the general Finnish male population, the age distribution was taken into account in two different ways. In both methods, consideration was given to the fact that during the period under review the subjects passed into age groups with a lower expectation of life.

#### *Method 1*

For each 5-year age group of amputees in Table 4 (age distribution at the beginning of 1945), the expected losses for the 5-year periods 1945-1949, etc., until the beginning of 1965, were calculated on the basis of the expectations of life indicated in the Statistical Yearbook of Finland, that figure being used which pertains to the mean age of the age group during the period in question. To exemplify, for those who were aged 20-24 years at the beginning of 1945, the expectation of life at 25 years was considered as the relevant figure for the period 1945-1949, since the youngest in the group had survived for 20-24 years and the oldest for 24-29 years. Correspondingly, the expectation of life at 30 years was applied to the period 1950-1955, etc. The 5-year losses were calculated on the basis of the total number of survivors. In Figure 2, the cumulative curve for the calculated losses from the level of 1945

TABLE 5. CAUSES OF DEATH OF 687 AMPUTEES IN A SERIES OF 4872

|  |     |                                  |           |
|--|-----|----------------------------------|-----------|
| Degenerative vascular diseases of the central nervous system |     | Injuries                         |           |
| Cerebral hemorrhage  | 32  | Traffic accident                 | 17        |
| Subarachnoidal hemorrhage                                    | 10  | Other accident                   | 10        |
| Cerebral embolism and thrombosis                             | 22  | Explosion                        | 1         |
|  | 64  | Work accident                    | 4         |
|  |     | Home accident                    | 2         |
| Degenerative cardiac and vascular diseases                   |     | Drowning                         | 11        |
| Cardiac infarction   | 148 | Burns                            | 1         |
| Pulmonary infarction   | 6   | Freezing                         | 1         |
| Arterial embolism  | 11  | Alcohol intoxication             | 11        |
| Myodegeneration of the heart                                 | 24  | Barbiturate intoxication         | 7         |
| Cardiac insufficiency  | 25  | Carbon monoxide poisoning        | 2         |
| Arteriosclerosis   | 5   | Homicide                         | 5         |
|  | 219 |                                  | 72        |
|  |     | Suicides                         |           |
| Rheumatic disease of the heart                               | 7   | Hanging                          | 24        |
|  |     | Shooting                         | 15        |
| Tuberculosis   |     | Poisoning                        | 10        |
| Pulmonary  | 70  | Drowning                         | 5         |
| Intestinal   | 2   | Cutting or piercing weapons      | 3         |
| Miliary  | 2   | Crushing                         | 6         |
|  | 74  |                                  | 63        |
|  |     | Miscellaneous diseases           |           |
| Malignant diseases   |     | Pneumonia                        | 12        |
| Mouth  | 2   | Bronchial asthma                 | 1         |
| Nose, pharynx  | 1   | Gastric and duodenal ulcer       | 6         |
| Jaw bones  | 2   | Acute appendicitis               | 3         |
| Esophagus  | 4   | Intestinal obstruction           | 8         |
| Stomach  | 31  | Peritonitis                      | 1         |
| Small intestine  | 1   | Cirrhosis of the liver           | 7         |
| Rectum   | 4   | Perforation of the gallbladder   | 1         |
| Liver  | 2   | Pancreatitis                     | 2         |
| Pancreas   | 4   | Chronic nephritis                | 30        |
| Lungs  | 29  | Meningitis, abscess of the brain | 4         |
| Mediastinum  | 2   | Paralysis agitans                | 2         |
| Prostate   | 2   | Poliomyelitis                    | 2         |
| Testes   | 1   | Septicemia                       | 5         |
| Kidneys  | 1   | Paratyphus                       | 1         |
| Bladder  | 2   |                                  | 85        |
| Brain  | 3   |                                  |           |
| Malignant lymphogranulomatosis                               | 1   | Senility                         | 1         |
| Myelomatosis   | 1   |                                  |           |
| Leukemia   | 2   | Unknown cause of death           | 6         |
| Undefined neoplasm   | 1   |                                  |           |
|  | 96  |                                  | Total 687 |

is compared to the cumulative curve for the actual losses.

The recorded death rates for the *5-year age groups* are slightly lower than the expected figures, but the difference is statistically insignificant. The same obtains

to the death rates as expressed by *5-year periods* (Table 6). The differences between the recorded and the expected figures are of the order of 10 per cent. The greatest differences relate to the periods 1950-1954 and 1955-1959, while for the



Fig. 2. Cumulative death rates-calculated for 5-year periods compared to cumulative expected death rates.

TABLE 6. MORTALITY AMONG 4738 WAR AMPUTEES DURING THE PERIOD 1945-1964 (5-YEAR PERIODS AND CUMULATIVE FIGURES) AND CORRESPONDING EXPECTED VALUES IN AN EQUIVALENT MALE POPULATION

| Period  | Deaths      |           | Difference in Per Cent | Cumulative Deaths |           | Difference in Per Cent |
|---------|-------------|-----------|------------------------|-------------------|-----------|------------------------|
|         | Re-recorded | Ex-pected |                        | Re-recorded       | Ex-pected |                        |
| 1945-49 | 95          | 97.3      | 2.3                    | 95                | 97.3      | 2.4                    |
| 1950-54 | 90          | 124.6     | 27.8                   | 185               | 221.9     | 16.6                   |
| 1955-59 | 146         | 168.7     | 13.5                   | 331               | 390.6     | 15.3                   |
| 1960-64 | 241         | 246.4     | 2.6                    | 572               | 637.0     | 10.4                   |
| 1945-64 | 572         | 637.0     | 10.4                   |                   |           |                        |

periods 1945-1949 and 1960-1964, the recorded figures fall below the expected ones by about 2 per cent only.

### Method II

In the Statistical Yearbook of Finland, the number of survivors among 100,000 men of the same age is indicated. On the basis of these figures, the numbers of expected survivors in all age classes represented in this series at the beginning of 1945 were calculated for the end of the age periods 20-24 years, 25-29 years, etc., and the expected death rates in the various age groups were expressed as percentages. The expected total mortality by the end of 1964, *i.e.*, 549, is in very

good agreement with the actual figure of 572. All the 687 deaths considered, the percentile distribution between the age groups corresponds fairly well to the expected distribution (Table 7, Fig. 3).

If the causes of death are disregarded, it may be stated that the mortality in the present series corresponds very closely to the mortality in the corresponding general population. This obtains to the figures for the various 5-year periods and the total mortality as well as to the figures for the age groups. There seems to be a tendency toward a lower mortality for am-

TABLE 7. DISTRIBUTION ACCORDING TO AGE AT DEATH OF 687 WAR AMPUTEES COMPARED TO THE GENERAL MALE POPULATION

| Age at Death | Deaths |          | Expected Mortality (per cent) |
|--------------|--------|----------|-------------------------------|
|              | Number | Per Cent |                               |
| 20-24        | 11     | 1.6      | 1.2                           |
| 25-29        | 48     | 7.0      | 3.8                           |
| 30-34        | 53     | 7.7      | 7.6                           |
| 35-39        | 72     | 10.5     | 12.4                          |
| 40-44        | 131    | 19.1     | 16.7                          |
| 45-49        | 144    | 21.0     | 18.7                          |
| 50-54        | 99     | 14.4     | 17.3                          |
| 55-59        | 71     | 10.3     | 11.9                          |
| 60-64        | 32     | 4.7      | 6.5                           |
| 65-69        | 14     | 2.0      | 2.2                           |
| 70-74        | 5      | 0.7      | 1.0                           |
| 75-79        | 3      | 0.4      | 0.6                           |
| 80-84        | 4      | 0.6      | 0.1                           |
| Total        | 687    | 100.0    | 100.0                         |

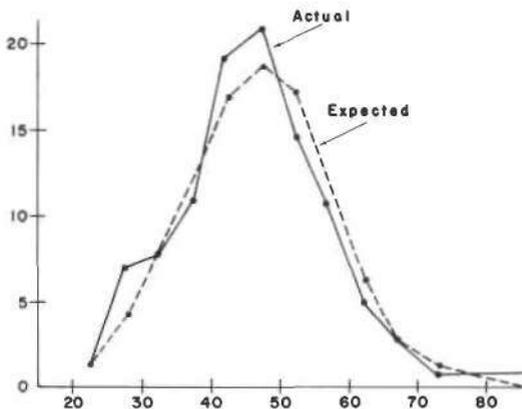


Fig. 3. Death rates for the different age groups compared to the expected death rates.

putees than in the general population, and, with regard to the age at death, it appears that among the amputees there may be a trend toward a lower age, though only by one or two years at the most.

#### DEGENERATIVE VASCULAR DISEASES OF THE CENTRAL NERVOUS SYSTEM

The mortality in degenerative vascular diseases of the central nervous system was 64/687 (9.3 per cent). Traumatic cerebral hemorrhages of course do not belong to this group. Comparable data relating to the general population was obtained from the Statistical Yearbook of Finland, and expected figures were calculated for the period 1945-1964 in the same way with respect to the total mortality. The expected number of deaths in this group of disease was 37.4. The actual number (64) was 71.2 per cent higher. In the age groups 25-44 years the actual number of deaths was 130.9 per cent higher than the expected number; in the age groups 45-64 years it was 49.6 per cent higher; and in the age groups 65-74 it was 28.6 per cent higher (Table 8). No consistent trend is discernible with regard to the age at death.

#### DEGENERATIVE CARDIAC AND VASCULAR DISEASES

This group includes cardiac infarction, pulmonary infarction, peripheral embolism, myodegeneration, cardiac insufficiency, and arteriosclerosis. The mortality in this group was 219/687 (31.9 per cent). The expected number of deaths in the general population was 134.3. The actual mortality was 63.1 per cent higher. As regards the different age groups, the actual mortality was 193.2 per cent higher than the expected in the group aged 25-44 years at death, 38.9 per cent higher in the group aged 45-64 years, and 28.6 per cent higher in the group aged 65-74 years (Table 8). One hundred and four amputees (47.5 per cent) died at an age of 45-54 years, 51 (23.3 per cent) at an age of 35-44 years, and 44 (20.1 per cent) at 55-

TABLE 8. DEATHS IN AMPUTEE POPULATION COMPARED WITH EXPECTED NUMBER IN GENERAL MALE POPULATION

| Age at Death (years) | Disease of the Central Nervous System |           |                      | Cardiac and Vascular Diseases |           |                      | Pulmonary Tuberculosis |           |                      | Malignancy |           |                      | Accidents |           |                      | Suicides  |           |                      | Miscellaneous |           |                      |  |
|----------------------|---------------------------------------|-----------|----------------------|-------------------------------|-----------|----------------------|------------------------|-----------|----------------------|------------|-----------|----------------------|-----------|-----------|----------------------|-----------|-----------|----------------------|---------------|-----------|----------------------|--|
|                      | Re-corded                             | Ex-pected | Per Cent Differ-ence | Re-corded                     | Ex-pected | Per Cent Differ-ence | Re-corded              | Ex-pected | Per Cent Differ-ence | Re-corded  | Ex-pected | Per Cent Differ-ence | Re-corded | Ex-pected | Per Cent Differ-ence | Re-corded | Ex-pected | Per Cent Differ-ence | Re-corded     | Ex-pected | Per Cent Differ-ence |  |
| 24                   | (0)                                   | (0.1)     |                      | 6                             | 2.2       | +172.7               | 0                      | 0.5       |                      | 1          | 4.6       | -78.3                | 4         | 1.0       | +300.0               |           |           |                      |               |           |                      |  |
| 25-44                | 18                                    | 7.8       | +130.9               | 56                            | 62.6      | -10.5                | 21                     | 25.1      | -16.4                | 46         | 72.1      | -36.2                | 40        | 26.00     | +53.8                |           |           |                      |               |           |                      |  |
| 45-64                | 41                                    | 27.4      | +49.6                | 148                           | 106.5     | +38.9                | 8                      | 90.0      | -21.1                | 25         | 32.1      | -24.1                | 19        | 18.7      | +1.6                 |           |           |                      |               |           |                      |  |
| 65-74                | 3                                     | 2.1       | +42.6                | 9                             | 7.0       | +28.6                | (1)                    | 3         | 3.8                  | -21.1      | (0)       | (0.6)                | 0         | 0.2       |                      |           |           |                      |               |           |                      |  |
| 75-                  | (2)                                   |           |                      | (1)                           |           |                      | (1)                    | (1)       |                      |            |           |                      |           |           |                      |           |           |                      |               |           |                      |  |
| Totals               | 64                                    | 37.4      | +71.2                | 219                           | 134.3     | +63.1                | 96                     | 119.4     | -19.6                | 72         | 109.4     | -34.2                | 63        | 45.9      | +37.3                | 103       | 147.4     | -30.1                |               |           |                      |  |

64 years. The remaining 20 deaths (9.1 per cent) were evenly distributed between the age groups 25-34 and 65-84 years (Table 1).

#### **PULMONARY TUBERCULOSIS**

The mortality in pulmonary tuberculosis was 70/687 (10.2 per cent). The actual mortality was found to be 24.9 per cent lower than the expected mortality (93.2 cases). In the group under 24 years of age the mortality was 172.7 per cent higher than the expected, while in the age groups 25-44 and 45-64 the actual mortality was 10.5 and 70.9 per cent lower, respectively, than the expected (Table 8).

#### **MALIGNANT DISEASES**

The mortality in malignant disease was 96/687 (14.0 per cent). The mortality was 19.6 per cent lower than the expected. In the age group 45-64 years the mortality was 21.1 per cent lower, and in the age group 65-74 it was also 21.1 per cent lower than the expected mortality. The frequency of malignant disease in different organs appears in Table 5. In none of the present cases was the disease a result of the amputation (Table 8).

#### **ACCIDENTS**

Accidents were the cause of death in 72/687 cases (10.5 per cent). The actual figures were in all age groups lower than the expected. In the age group under 24, the recorded number of deaths was 78.3 per cent lower than the expected mortality; in the group 25-44 years it was 36.2 per cent lower; in the group 45-64 years it was 24.1 per cent lower. The actual total mortality was 34.2 per cent lower than the expected. This group includes 17 (2.5 per cent) traffic accidents, but these could not be separately analyzed, because traffic accidents are not treated as a separate group in the Statistical Yearbook (Table 8).

It thus appears that the mortality from accidents was markedly lower among the amputees than in the general population. It might have been expected that ampu-

tees would be more accident-prone both at work and in the traffic, owing to their poorer mobility. The small proportion of traffic accidents among the total number of cases is also striking. Obviously, the amputees move about less than the general population, work at less dangerous places, and are, perhaps, employed to a lesser extent owing to their reduced working capacity.

#### **SUICIDES**

Since about 80 per cent of the suicides are committed by men, it seemed reasonable to use this age distribution as a basis when the expected mortality was calculated in the same way as for the other causes of death. The actual figures for the periods 1955-1959 and 1960-1964 are 68.1 and 36.0 per cent higher than the expected figures. The total number of suicides (63) for the period 1945-1964 is 37.3 per cent greater than the expected number. The greatest difference is noted for the period 1945-1949, the recorded frequency of suicides being 3.6 times higher (260.0 per cent) than the expected (Table 8). By contrast, the figure for 1950-1954 is 73.4 per cent lower than the expected mortality. If these two 5-year groups are added together the difference by which the actual frequency of suicides exceeds the expected has changed to a decrease (-13.8 per cent).

It appears that among amputees under 25 years of age, suicides were 300.0 per cent higher, and in the age group 25-44 years 53.8 per cent higher than was to be expected on the basis of the statistics for the general population. By contrast, the number of suicides committed by amputees aged 65-74 years was within 0.2 per cent of the expected figure. The total actual number of suicides exceeds the expected figure by a difference of 37.3 per cent (Table 8).

In addition, the rate of suicides among the dead amputees with the same occupation has been calculated. In this respect there is no major difference between heavy labor and other occupations. Tech-

TABLE 9. DISTRIBUTION OF 63 AMPUTEES, WHO COMMITTED SUICIDE, ACCORDING TO SITE OF AMPUTATION

| Amputation  | Number | Per Cent |      |
|-------------|--------|----------|------|
| Above-elbow | 5      | 7.9      | 30.2 |
| Below-elbow | 14     | 22.3     |      |
| Above-knee  | 13     | 20.7     | 61.8 |
| Below-knee  | 26     | 41.1     |      |
| Others      | 5      | 8.0      | 8.0  |
| Total       | 63     | 100.0    |      |

nicians have the lowest rate of suicide, those with unknown occupations the highest. With regard to the former, it may be pointed out that their occupation is highly suitable for amputees, while the latter group includes subjects without regular employment, who lived in poor social conditions.

The possible relationship between the rate of suicides and the level and site of the amputation is analyzed in Table 9. Among lower-limb amputees the frequency of suicide was twice the frequency among upper-limb amputees. However, when the whole series is taken into account, the difference is not very great, the number of lower-limb amputees being double the number of upper-limb amputees.

The methods of suicide appear in Table 5. Alcohol abuse was known to have played a part in 11 cases, and 6 subjects had used barbiturates in addition. This group of 63 consists of only sure cases of suicide. In the group of accidents, at least a slight suspicion of suicide was present in many cases.

#### SUMMARY AND DISCUSSION

In a series of 4782 war amputees, the total mortality was 687 (14.4 per cent). The period covered by the present study is from 1945 till the end of 1965. In 1960, the mortality of the war amputees began to rise abruptly, and was one of the causes for undertaking this study. This mortality was compared to the mortality in the general Finnish male population. A theoretical, equivalent male popula-

tion was constructed on the basis of data obtained from the Statistical Yearbook of Finland.

When the causes of death were not differentiated, the mortality of the amputees was found to be in good agreement with the mortality of the general population. This obtains to both the whole series and the different 5-year periods. There was even a tendency towards slightly lower figures for the amputees.

On the other hand, when the causes of death were differentiated, certain features of interest emerged. The recorded death rates were higher than the expected figures with regard to degenerative diseases of the central nervous system (+71.2 per cent), degenerative cardiac and vascular diseases (+63.1 per cent), and suicide (+37.3 per cent). These were the causes of death in half the cases. One-fourth of the deaths were due to pulmonary tuberculosis or malignant disease. In both these groups the actual death rate was lower than the expected (—24.9 per cent and —19.6 per cent). In the age group under 25, the mortality in pulmonary tuberculosis was 2.7 times higher than in the corresponding group of the general population, but in all other age groups it was lower than the expected death rate. The number of deaths due to accidents (72) fell below the expected mortality by 34.2 per cent. Obviously, amputees move about considerably less than the general population, and they are less exposed to accidents owing to their limited working capacity.

In order to give a general survey of the findings, the main causes of death are listed in Table 8. In addition to the number of deaths, the mortality in each group is expressed as a percentage. Likewise, the expected mortality is given both in absolute figures and as percentages, and the differences between the actual and expected figures are indicated in percentages. In this connection, it has been assumed that the total expected mortality is the same as the actual mortality, as was also suggested by the analysis of the

total mortality carried out at the beginning of this study. The amputees seem to be more afflicted with fatal degenerative diseases of the central nervous system and fatal degenerative cardiac and vascular diseases, and suicides seem to be more common among them, as compared with the general population. On the other hand, the mortality from pulmonary tuberculosis, accidents, and a large group of miscellaneous diseases (*e.g.*, various diseases of the lungs and abdominal disorders), was lower among the amputees than in the general population.

It may be assumed that the higher frequency of suicides among the amputees is due in part to psychological causes connected with the loss of a limb. Also, a postwar depression may have become more pronounced with the lapse of time. Economic problems and poor social conditions may be regarded as contributory causes.

In the care of amputees, the factors of importance are: a satisfactory prosthesis, good condition of the stump, rehabilitation, suitable employment, and judiciously administered subvention. The question arises as to whether all that could have been done for the war amputees was done. Perhaps something had been neglected

that could have prolonged the lives in some cases.

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