

Chapter IV

NONCAUSE SPECIFIC COMPARISONS WITH EXTERNAL POPULATIONS

1. Background and Motivation

It is important to know, not only how the Ranch Handers and their matched comparisons relate to each other, but also how they compare with general military and male United States populations. Pitfalls inherent in these comparisons are well known and are briefly reviewed below for specific comparisons with 1978 DoD period life tables for nondisability retired military officer and enlisted personnel (15) and the 1978 U.S. White Male Life Table (16). Although there are difficulties in the use of these comparisons, their use does provide an additional indicator of trends in mortality when viewed in the context of the total analytic process.

2. Adjustment Difficulties

Mortality rates in any military population are strongly dependent upon 1) calendar year of death, 2) military status (active duty, separated, retired), 3) selection and retention, and 4) branch of service. Adjustment for these effects was not made in these comparisons because published select Air Force life tables, by calendar year and by status, are not available. In addition, there is also a problem with the statistical method used, since the Gail and Ware (17) procedure assumes constant relative risk with respect to age; the selection effect has been shown to diminish sharply with time making this assumption untenable in these comparisons. The adjustment difficulties (1-4), and their likely consequences, are detailed below. These difficulties apply to all of the comparison groups, but these concerns have less effect on the comparisons of the Ranch Hand group to their matched cohort since these two groups are generally equivalent, relative to these key factors.

A. Adjustment for Calendar Year of Death

Due to the continuing decrease in overall mortality in the military (18) and in the United States (19), the referenced external age-specific rates are appropriate only for the calendar period of the referenced external life table, that is, 1977-79 for the 1978 period military table used in this analysis. The 1977-79 period rates would, for example, be too low for comparison with subjects dying in 1970 at the age of 40. These subjects would more properly be compared with the death rate for 40 year olds in a 1970 period life table or with a death rate for 40 year olds in a cohort military life table for subjects born in 1930. Calendar time is not taken into account in this analysis because period life tables covering the three decades from 1950 to 1980, for the the active duty, separated and retired Air Force subpopulations, are not currently available. This discrepancy is serious because the decline in death rates in the active duty Air Force during the period 1966 to 1980 has been very substantial (18).

B. Adjustment for Military Status (Active Duty, Separated, Retired).

The only published military life tables available at this writing are 1978 period tables for DoD nondisability retired officer and enlisted personnel (15) and a series of yearly abridged tables for the active duty Air Force, the first covering the period 1966-1968 and the last, 1978-1980 (18). With these data limitations, adjustment for military status is not possible. It is

clear, however, that there are substantial differences between active duty and retired death rates with the active duty rates being lower than retired rates (15).

C. Adjustment for Selection

Entry into the military carries with it an effect known as selection, a lengthening of life expectancy due to health prerequisites upon entry into select status and periodic health checks thereafter. This effect is well known to insurance actuaries who have observed that, in insured populations, the effect diminishes as time passes unless there are continued checks on the state of health of the insured persons (20). If selection is to be adjusted for in this analysis, it would be necessary to know Air Force death rates as a function of both age and of time elapsed since entry into the Air Force. It would also be necessary, therefore, to know enlistment and discharge or retirement dates for all study subjects. It is the lack of these data that makes this adjustment impossible at this time. The consequences of this lack of adjustment are not known at this writing.

D. Adjustment for Branch of Service

Age specific active duty Air Force death rates are substantially lower than the corresponding rates for other services (18). Nonservice specific death rates are therefore too high for appropriate comparison with these two study groups.

3. Comparisons with 1978 DoD Life Tables

In Tables 22 and 23, Ranch Hand officers and comparison group officers are contrasted to a 1978 DoD nondisability retired officer life table (15) and in Tables 24 and 25, Ranch Hand and comparison group enlisted personnel are compared with a 1978 DoD nondisability retired enlisted life table (15). In each table, the column labeled "At Risk" lists the number of subjects entering each five year age interval, the column labeled "Deaths" tabulates the numbers of deaths in the age intervals and the column labeled "Expected Deaths" gives the expected numbers of deaths in the age intervals if the study subjects had experienced the same death rates as those specified by the DoD table. The value of the test statistic (17) for testing the null hypothesis of equality is denoted by T ; its two-sided P -value is denoted by P . While each table summarizes the findings with five year age intervals for ease of presentation, one year age intervals were used for the computation of the statistic T . All comparisons are conditioned on survival to age 35, since the DoD tables begin at that age. All comparisons are unadjusted for race since the DoD tables are not race specific.

Table 22

RANCH HAND OFFICER VERSUS DOD NONDISABILITY
 RETIRED OFFICER LIFE TABLE
 (T = -3.962, P < .001)

| <u>Age</u> | <u>At Risk</u> | <u>Deaths</u> | <u>Expected Deaths</u> |
|------------|----------------|---------------|------------------------|
| 35-39 | 456 | 2 | 4.183 |
| 40-44 | 366 | 1 | 4.244 |
| 45-49 | 288 | 1 | 4.578 |
| 50-54 | 173 | 1 | 3.099 |
| 55-59 | 57 | 1 | 2.043 |
| 60-64 | 30 | 2 | .823 |
| 65-68 | 1 | 0 | .076 |
| | | <u>8</u> | <u>19.046</u> |

Table 23

COMPARISON OFFICERS VERSUS DOD NONDISABILITY
 RETIRED OFFICER LIFE TABLE
 (T = -2.402, P = .016)

| <u>Age</u> | <u>At Risk</u> | <u>Deaths</u> | <u>Expected Deaths</u> |
|------------|----------------|---------------|------------------------|
| 35-39 | 2264 | 12 | 20.837 |
| 40-44 | 1822 | 13 | 20.703 |
| 45-49 | 1365 | 24 | 21.920 |
| 50-54 | 842 | 12 | 15.901 |
| 55-59 | 308 | 9 | 10.265 |
| 60-64 | 145 | 4 | 4.377 |
| 65-68 | 19 | 0 | .601 |
| | | <u>74</u> | <u>94.604</u> |

Table 24

ENLISTED RANCH HANDERS VERSUS DOD NONDISABILITY
 RETIRED ENLISTED LIFE TABLE
 (T = -.239, P = .811)

| <u>Age</u> | <u>At Risk</u> | <u>Deaths</u> | <u>Expected Deaths</u> |
|------------|----------------|---------------|------------------------|
| 35-39 | 668 | 6 | 6.748 |
| 40-44 | 392 | 5 | 5.601 |
| 45-49 | 287 | 5 | 6.326 |
| 50-54 | 140 | 5 | 4.154 |
| 55-59 | 41 | 2 | 2.203 |
| 60-64 | 20 | 2 | 1.484 |
| 65-69 | 6 | 0 | .576 |
| 70-71 | 1 | 1 | .096 |
| | | <u>26</u> | <u>27.188</u> |

Table 25

ENLISTED COMPARISON SUBJECTS VERSUS DOD NONDISABILITY
 RETIRED ENLISTED LIFE TABLE
 (T = -3.214, P = .001)

| <u>Age</u> | <u>At Risk</u> | <u>Deaths</u> | <u>Expected Deaths</u> |
|------------|----------------|---------------|------------------------|
| 35-39 | 3299 | 21 | 33.370 |
| 40-44 | 1945 | 20 | 27.681 |
| 45-49 | 1437 | 31 | 31.450 |
| 50-54 | 695 | 14 | 20.076 |
| 55-59 | 203 | 12 | 10.980 |
| 60-64 | 103 | 3 | 7.515 |
| 65-59 | 35 | 1 | 2.593 |
| 70-74 | 5 | 0 | .646 |
| | | <u>102</u> | <u>134.311</u> |

These findings suggest that, if the effects discussed in section 2 are assumed to be negligible, Ranch Hand officers and comparison officers and comparison enlisted personnel are living longer than expected relative to their respective external populations. Enlisted Ranch Hand personnel are not different from DoD enlisted personnel. In the above DoD comparison there is a suggestion of interaction between officer-enlisted categories and Ranch Hand versus comparison group membership. If matching and time of death are ignored, the following table can be constructed. The term "rate" is as defined on page 8 of this report.

Table 26

DEATH AFTER 35 YEARS

| | <u>Ranch Hand</u> | | | <u>Comparison</u> | | |
|----------|-------------------|-------------|-------------|-------------------|-------------|-------------|
| | <u>Alive</u> | <u>Dead</u> | <u>Rate</u> | <u>Alive</u> | <u>Dead</u> | <u>Rate</u> |
| Officer | 448 | 8 | .018 | 2190 | 74 | .033 |
| Enlisted | 642 | 26 | .039 | 3197 | 102 | .031 |

Analysis using log-linear models shows a statistically significant interaction with $p \leq 0.05$. It appears that Ranch Hand officers have a lower mortality after age 35 than Ranch Hand enlisted or comparison officers or enlisted. However, the converse situation is noted considering mortality prior to age 35 and is significant with $p \leq 0.05$. The data for this analysis of mortality prior to age 35 is set out below.

Table 27

DEATHS BEFORE AGE 35 YEAR

| | <u>Ranch Hand</u> | | | <u>Comparison</u> | | |
|----------|-------------------|-------------|-------------|-------------------|-------------|-------------|
| | <u>Alive</u> | <u>Dead</u> | <u>Rate</u> | <u>Alive</u> | <u>Dead</u> | <u>Rate</u> |
| Officer | 456 | 7 | .015 | 2264 | 14 | .006 |
| Enlisted | 775 | 9 | .011 | 3833 | 60 | .015 |

These interactions will require further detailed analysis and evaluation, with specific consideration of medical covariables including risk taking, other life patterns and herbicide.

4. Comparisons with U.S. 1978 White Male Life Table

Non-Black Ranch Handers and non-Black comparisons are compared in this section with the population of White males, as represented by the 1978 U.S. White Male Life Table (16). Two serious and well known problems with the use of this table are the lack of adjustments for the calendar year and selection effects just described; when comparing occupational cohorts with national populations, the selection effect is known as the "healthy worker" effect. The pitfalls of these kinds of comparisons are well documented (21, 22, 23). In Tables 28 and 29, non-Black Ranch Handers and non-Black comparisons are compared, via the method of Gail and Ware (17), with the 1978 U.S. White Male Life Table (16). In Tables 30 through 33, non-Black officers and enlisted personnel in both study groups are compared with the same 1978 U.S. White Male Table.

Table 28

NON-BLACK RANCH HANDERS VERSUS 1978 U.S. WHITE MALE
LIFE TABLE
($T=-4.588$, $P < .001$)

| <u>Age</u> | <u>At Risk</u> | <u>Deaths</u> | <u>Expected Deaths</u> |
|------------|----------------|---------------|------------------------|
| 21-24 | 1171 | 2 | 9.003 |
| 25-29 | 1169 | 6 | 9.783 |
| 30-34 | 1163 | 7 | 9.396 |
| 35-39 | 1054 | 7 | 9.256 |
| 40-44 | 722 | 5 | 10.381 |
| 45-49 | 549 | 6 | 12.085 |
| 50-54 | 304 | 5 | 8.114 |
| 55-59 | 98 | 3 | 5.039 |
| 60-64 | 50 | 4 | 2.790 |
| 65-69 | 7 | 0 | 0.669 |
| 70-71 | 1 | 1 | 0.089 |
| | | <u>46</u> | <u>76.605</u> |

Table 29

NON-BLACK COMPARISONS VERSUS THE 1978 U.S. WHITE MALE
LIFE TABLE

(T = -11.230, P < .001)

| <u>Age</u> | <u>At Risk</u> | <u>Deaths</u> | <u>Expected Death</u> |
|------------|----------------|---------------|-----------------------|
| 19-19 | 5816 | 1 | 10.325 |
| 20-24 | 5815 | 16 | 55.444 |
| 25-29 | 5799 | 27 | 48.592 |
| 30-34 | 5772 | 23 | 46.719 |
| 35-39 | 5245 | 31 | 46.124 |
| 40-44 | 3593 | 29 | 51.041 |
| 45-49 | 2675 | 50 | 58.810 |
| 50-54 | 1487 | 26 | 40.529 |
| 55-59 | 509 | 20 | 25.210 |
| 60-64 | 248 | 7 | 14.461 |
| 65-69 | 54 | 1 | 3.403 |
| 70-74 | 5 | 0 | 0.601 |
| | | <u>231</u> | <u>354.540</u> |

Table 30

NON-BLACK RANCH HAND OFFICERS VERSUS 1978 U.S. WHITE MALE
LIFE TABLE

(T = -4.575, P < .001)

| <u>Age</u> | <u>At Risk</u> | <u>Deaths</u> | <u>Expected Deaths</u> |
|------------|----------------|---------------|------------------------|
| 25-29 | 454 | 3 | 3.794 |
| 30-34 | 451 | 4 | 3.710 |
| 35-39 | 447 | 2 | 4.420 |
| 40-44 | 362 | 1 | 5.304 |
| 45-49 | 285 | 1 | 6.370 |
| 50-54 | 172 | 1 | 4.541 |
| 55-59 | 57 | 1 | 3.019 |
| 60-64 | 30 | 2 | 1.302 |
| 65-68 | 1 | 0 | 0.110 |
| | | <u>15</u> | <u>32.570</u> |

Table 31

NON-BLACK COMPARISON OFFICERS VERSUS 1978 U.S. WHITE MALE
LIFE TABLE
(T = -7.923, P < .001)

| <u>Age</u> | <u>At Risk</u> | <u>Deaths</u> | <u>Expected Deaths</u> |
|------------|----------------|---------------|------------------------|
| 25-29 | 2253 | 9 | 18.880 |
| 30-34 | 2244 | 5 | 18.530 |
| 35-39 | 2239 | 12 | 22.137 |
| 40-44 | 1801 | 13 | 25.841 |
| 45-49 | 1352 | 24 | 30.468 |
| 50-54 | 834 | 12 | 23.328 |
| 55-59 | 308 | 9 | 15.157 |
| 60-64 | 145 | 4 | 6.923 |
| 65-68 | 19 | 0 | 0.887 |
| | | <u>88</u> | <u>162.151</u> |

Table 32

NON-BLACK RANCH HAND ENLISTED PERSONNEL VERSUS 1978 U.S. WHITE MALE
LIFE TABLE
(T = -1.753, P = .080)

| <u>Age</u> | <u>At Risk</u> | <u>Deaths</u> | <u>Expected Deaths</u> |
|------------|----------------|---------------|------------------------|
| 21-24 | 717 | 2 | 5.510 |
| 25-29 | 715 | 3 | 5.988 |
| 30-34 | 712 | 3 | 5.686 |
| 35-39 | 607 | 5 | 4.836 |
| 40-44 | 360 | 4 | 5.077 |
| 45-49 | 264 | 5 | 5.716 |
| 50-54 | 132 | 4 | 3.573 |
| 55-59 | 41 | 2 | 2.020 |
| 60-64 | 20 | 2 | 1.488 |
| 65-69 | 6 | 0 | 0.588 |
| 70-71 | 1 | 1 | 0.089 |
| | | <u>33</u> | <u>40.571</u> |

Table 33

NON-BLACK COMPARISON ENLISTED PERSONNEL VERSUS THE 1978 U.S. WHITE MALE
LIFE TABLE
(T = -5.923, P < .001)

| <u>Age</u> | <u>At Risk</u> | <u>Deaths</u> | <u>Expected Death</u> |
|------------|----------------|---------------|-----------------------|
| 19-19 | 3563 | 1 | 6.325 |
| 20-24 | 3562 | 16 | 33.938 |
| 25-29 | 3546 | 18 | 29.713 |
| 30-34 | 3528 | 18 | 28.189 |
| 35-39 | 3006 | 19 | 23.987 |
| 40-44 | 1792 | 16 | 25.200 |
| 45-49 | 1323 | 26 | 28.341 |
| 50-54 | 653 | 14 | 17.201 |
| 55-59 | 201 | 11 | 10.053 |
| 60-64 | 103 | 3 | 7.538 |
| 65-69 | 35 | 1 | 2.515 |
| 70-74 | 5 | 0 | 0.601 |
| | | <u>143</u> | <u>213.601</u> |

Given the cautions just described, these findings suggest that the non-Black Ranch Handers and comparisons are living much longer than expected relative to the 1978 U.S. White Male Life Table. The ratios of the observed to the expected deaths described in Tables 28 and 29 reveal that the Ranch Hand and comparison subjects are experiencing death at only 60 to 65% of the rate of the U.S. White male population. The ratio is 0.461 for the subset of Ranch Hand officers, 0.543 for comparison officers, 0.813 for enlisted Ranch Handers, and 0.669 for enlisted comparison subjects. The healthy worker effect is very likely a major contributor to the undoubtedly real differences between these study groups and the general population.