
Deaths Among Members of the Public Health Service Commissioned Corps, 1965–89

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Synopsis

The U.S. Public Health Service Commissioned Corps performs health promotion and disease pre-

vention activities and provides clinical care. The authors examined the epidemiology of deaths among active duty personnel and the hypothesis that, based on the mission, mortality would be less than in the general population, and that deaths would reflect nonpreventable causes. A retrospective record review for the period 1965–89 showed 118 active duty deaths, 26 percent of the number anticipated in a general population group adjusted for age, sex, and race or ethnicity.

The five major causes of death were coronary heart disease, suicide, motor vehicle crash, malignant neoplasm, and drowning. Beginning with the mid-1980s, infectious disease became a principal cause of death, the only cause for which the rate trended upward. Among professionals, death rates were highest among sanitarians and veterinarians, and lowest among pharmacists. The only causes for which deaths exceeded the expected number involved suicides and possibly deaths related to acquired immunodeficiency syndrome. Active duty status in the Commissioned Corps was associated with a death rate less than that of comparable groups in the general population. Many of the premature deaths were attributable to preventable causes.

THE PUBLIC HEALTH SERVICE COMMISSIONED CORPS differs from most uniformed services in that it has commissioned officers but no enlisted or warrant officer personnel. Commissioned Corps members have high levels of education; all are college graduates, more than two-thirds have doctoral degrees, and about a third are physicians.

The Commissioned Corps performs health promotion and disease prevention activities and provides clinical care. Because of its unusual composition and mission, mortality rates for Commissioned Corps members could be expected to be appreciably lower than those of a general population group adjusted for age, sex, and race or ethnicity. Deaths among members might tend to reflect nonpreventable causes.

The Office of the Surgeon General's Division of Commissioned Personnel (DCP), Medical Branch, has responsibilities for providing direction, surveillance, and review of clinical services and maintains records on deaths of active duty and retired members of the Commissioned Corps.

Mortality records for members of the Commissioned Corps for the period 1965–89 were compiled by the Medical Branch. A list of deaths of active duty members and of those who died within 12 months of permanent or temporary disability retirement was provided by DCP. To assure completeness, the list was compared with one separately compiled by the Medical Branch. Demographic, personnel, and clinical information were extracted from Medical Branch and DCP records.

Mortality data for Commissioned Corps members were compared to vital statistics data for the general population that were compiled by the National Center for Health Statistics (1), using 1977, the mid-point in the surveillance period, as the reference year. The median age for an active duty officer during the surveillance period was 40 years. The age-specific mortality rate for those 35–44 years of age in 1977 was adjusted for race or ethnicity, yielding an expected mortality rate for Commissioned Corps members of 305.4 deaths per 100,000.

Cause-specific mortality rates for 1980 were used for comparison purposes, 1980 being the year for which data were available that was closest to the reference year of 1977. Cause-specific rates were given separately for 35-39- and 40-44-year olds, and the mean of the two rates was used. Supplemental mortality data were used to compute cause-specific rates by age, race, and sex (2).

The overall number of deaths was compared to the expected number of deaths using the chi-square test. The normal test for differences in proportions was used for comparing the observed versus the expected proportions of deaths within specific categories of death. The test for linear trends in proportions was used to test for changes in the proportions of specific causes of deaths.

Results

During the study period, mid-year Commissioned Corps personnel strength varied between 5,323 in 1974 and 7,359 in 1980. The median mid-year active duty strength was 5,782. In addition to variations in the size of the Commissioned Corps, there were changes in the pattern of staffing. There was a distinct trend towards more women and members of minority groups, and the number of medical officers tended to decrease. During the study period, the Commissioned Corps was 84 percent white, 16 percent nonwhite, 80 percent men, and 20 percent women.

During the study period, there were 150,161 person-years of active duty exposure and 118 active duty deaths. The number of deaths expected in a general population group adjusted for age, sex, and race or ethnicity would have been 459; the difference was significant ($\chi^2 = 253.3$, $P < 0.0001$). As shown in table 1, mortality was highest in the period 1970-74, and the ratio of observed to expected deaths tended to decrease during the study period, although the trend was not statistically significant. The median age of officers dying on active duty was 45 years.

The distribution of active duty deaths by forensic manner of death, that is, natural cause, accidental cause, suicide, or homicide, was different from that expected for matched general population groups. As shown in table 2, the proportion of deaths by natural cause was lower than expected, and the proportion from accidental cause and suicide was higher. For all categories of death except suicide, the observed number of deaths was lower than that expected. No significant trends were detected in the distribution of manner of death in the period.

Table 1. Deaths of Public Health Service Commissioned Corps members on active duty, by 5-year intervals, 1965-89

Period	Person-years of exposure	Deaths		Ratio of observed to expected ¹
		Observed	Expected	
1965-69.....	² 30,780	25	94	0.27
1970-74.....	27,566	31	84	0.37
1975-79.....	30,688	21	94	0.22
1980-84.....	² 32,692	24	100	0.24
1985-89.....	28,435	17	87	0.20
Total.....	150,161	118	459	0.26

¹ The overall number of observed deaths is significantly less than would be expected ($\chi^2 = 253.3$, $P < 0.0001$); however, the ratio of observed to expected does not show a significant decrease during the period ($b = -0.027$; 95 percent CI = -0.140 , 0.086).

² Commissioned Corps strength estimated for some years.

Table 3 lists the five major causes of death among active duty personnel during the period. Coronary heart disease was the leading cause, followed by suicide. Table 4 shows the 58 (49 percent) deaths from natural causes, which accounted for the largest number overall.

During the first 20 years, coronary heart disease, followed by malignancy, was the leading cause of natural death, and both showed significant decreases during the period. The observed number of deaths from coronary disease approximated the expected number, but the observed number of malignancy deaths was 19 percent of that expected. During the last 5 years, infectious diseases resulted in the largest number of deaths; 75 percent of deaths from infectious diseases were attributable to acquired immunodeficiency syndrome (AIDS).

Table 5 shows the distribution of death by unintentional injury. There were no distinct trends during the study period. Motor vehicle crashes accounted for nearly half the deaths from unintentional injury, drowning for more than a quarter, and aircraft crashes for nearly an eighth.

Table 6 shows the distribution of the methods of suicide; however, official records did not specify the means of death for 25 percent of the cases. When the cause was specified, drug overdose was the leading means (33 percent), followed by hanging (22 percent), and gunshot wounds and jumping (17 percent each).

Table 7 shows deaths among professional categories. Risk ratios (RR) were significantly higher for sanitarians (RR = 3.46) and veterinarians (RR = 2.42), and significantly lower for pharmacists (RR = 0.37). Deaths from unintentional injury were significantly higher among veterinarians. Suicides were significantly higher among sanitarians, veteri-

Table 2. Deaths of Public Health Service Commissioned Corps members on active duty, distribution by cause of death, 1965–89

Cause	Observed		Expected		Ratio of observed to expected	P ¹
	Number	Percent	Number	Percent		
Natural	58	49	322	70	0.18	0.0001
Accidental	34	29	109	24	0.31	0.2227
Suicide	24	20	18	4	1.33	0.0001
Homicide	2	2	10	2	0.2	1.0000
Total	100	118	100	459	...	...

¹ P = probability that the 2 proportions are significantly different.

Table 3. The five leading causes of death of Public Health Service Commissioned Corps members on active duty, 1965–89

Rank	Cause of death	Number of deaths	Percent of deaths
1	Coronary heart disease ...	30	25
2	Suicide	24	20
3	Motor vehicle crash	16	14
4	Malignant neoplasm	15	13
5	Drowning	9	8

narians, and dietitians. However, the actual number of deaths and the number of officers in some of the professional categories was so low as to make interpretation difficult.

Mortality data for members on active duty during the 1980s were compared with that of officers dying within 12 months of retirement for permanent or temporary disability. Officers are retired if they become seriously ill or injured. By comparing and combining the two groups, we anticipated that a more complete mortality picture would evolve.

During the 1980s, there were 41 deaths among active duty personnel. Twenty-two (54 percent) deaths were from natural causes (19 men and 3 women). Of these, 8 deaths were attributable to coronary heart disease, all were of men, and their median age was 50 years, ranging from 33 through 63 years. Three deaths were the result of cerebrovascular accident, four were from malignancy, four from infection, and three from another cause (ruptured abdominal aortic aneurysm, amyotrophic lateral sclerosis, and cirrhosis of the liver). Three of the four deaths from infectious disease were the result of AIDS. The ages of the deceased were 32, 43, and 44 years.

There were 12 deaths of persons on active duty from unintentional injury during the 1980s (9 men and 3 women). The median age was 42 years,

ranging from 29 through 61 years. The median age for men was 40 years and 49 for women. Nine of the deaths (75 percent) occurred in rural or remote areas: Alaska, three; Montana, two; Arizona, one; Guam, one; Idaho, one; and Oklahoma, one. Four unintentional injury deaths and one death from a natural cause (12 percent of all deaths of active duty personnel) occurred in a national park or national wilderness. Motor vehicle crashes, including a pedestrian death, resulted in five deaths; drowning accounted for two; aircraft crashes, two; hunting deaths, one; fall, one; and uncertain cause, one. Both aircraft crashes were in the general aviation category and were small aircraft operating in Alaska.

There were six suicides of active duty members, five men and one woman; their median age was 40 years, ranging 27–44 years. Drug overdose accounted for three deaths, followed by hanging, gunshot wound, and jumping, one each. During the first half of the decade there were four suicides and two in the second half. There was one homicide, a 48 year-old man who was a stabbing victim in Arizona in 1983.

During the decade of the 1980s there were 24 deaths (21 men and 3 women) occurring within a year after disability retirement. The median age of death was 55 years. Twenty-two deaths were from natural causes and two from unintentional injury (one motor vehicle crash and one aircraft crash). Malignancy was the leading cause of death in this group (50 percent). The median age of death from cancer was 44 years, ranging 37–67 years, and the median period of separation from active duty before death was 2 months. Three cancer deaths occurred among recently retired women officers; two died of breast cancer and one from cancer of an unknown primary site, resulting in death within 1 day of separation. Two officers, both physicians younger than 40 years, died of cancer; one was from a lymphoma, the other from a glioblastoma.

Table 4. Natural causes of death of Public Health Service Commissioned Corps members on active duty, by 5-year intervals, 1965-89

Cause	1965-69	1970-74	1975-79	1980-84	1985-89	Total	Percent
Coronary heart disease	5	12	4	6	3	30	52
Cerebrovascular disease	1	0	0	2	0	3	5
Malignancy	5	1	4	3	1	14	24
Infectious disease	1	0	0	0	4	5	9
Miscellaneous	1	1	1	2	1	6	10
Total	13	14	9	13	9	58	100

Table 5. Causes of death from unintentional injury of Public Health Service Commissioned Corps members on active duty, by 5-year intervals, 1965-89

Cause	1965-69	1970-74	1975-79	1980-84	1985-89	Total	Percent
Automobile crash	3	4	4	1	4	16	47
Drowning	1	4	2	2	0	9	26
Aircraft crash	1	1	0	0	2	4	12
Motorcycle crash	0	0	2	0	0	2	6
Miscellaneous ¹	0	0	0	3	0	3	9
Total	5	9	8	6	6	34	100

¹ Miscellaneous causes include hunting fatality, laceration, and fall.

Table 8 contrasts cancer deaths of active duty personnel and recently separated officers. In both categories, the ratio of men to women was three to one. Overall, lymphoma and breast and colon cancer were the principal categories, with three deaths attributable to each. Together they accounted for 56 percent of cancer deaths. There was only one death from lung cancer, a 57-year old sanitarian with oat-cell carcinoma. Coronary heart disease accounted for four deaths of recently retired personnel, all men. Their median age was 56 years, ranging from 46 through 58 years. Their median period of separation was 6 months, ranging from 2 through 10 months. Two deaths of retired personnel were attributable to cerebrovascular events. Both were men and both incidents were hemorrhagic. The four additional deaths were to men and attributable to AIDS, hypertensive heart disease, amyotrophic lateral sclerosis, and cirrhosis.

Discussion

We demonstrated that mortality rates among active duty personnel were 26 percent of those expected, and that the distribution of deaths was different from that of matched general population groups. Factors that could account for the lower numbers include the fact that applicants to the

Table 6. Method of suicide by Public Health Service Commissioned Corps members on active duty, 1965-89

Cause	Number	Percent of specified causes
Drug overdose	6	33
Hanging	4	22
Gunshot wound	3	17
Jumping	3	17
Suffocation	2	11
Not specified	6	...
Total	24	100

Commissioned Corps undergo a comprehensive screening process, and those with selected pre-existing medical conditions are excluded. Additionally, all active duty Commissioned Corps members receive periodic health assessments that screen for age-specific conditions. Monitoring not only emphasizes health promotion and disease prevention, but can be expected to detect potentially serious problems at an early stage, decreasing the likelihood of fatal outcome. When serious illness with a potentially fatal outcome becomes apparent, most officers are separated from active duty through (a) voluntary inactivation by the officer, (b) administrative separation of a recent appointee because of a preexisting condition or nondisclosure of an illness or condition, or (c) medical retirement, if

Table 7. Causes of death of Public Health Service Commissioned Corps members on active duty, by professional category, 1965-89

Category	Percent of Corps in 1980	Total deaths	Number of deaths by cause				All deaths ¹		Accidental ¹		Suicides ¹	
			Natural	Accidental	Suicide	Homicide	Percent	RR	Percent	RR	Percent	RR
Medical	34.6	36	18	10	8	0	34.6	1.00	35.7	1.03	38.1	1.10
Dental	12.0	13	5	4	4	0	12.5	1.04	14.3	1.19	19.0	1.58
Nurse	8.5	6	3	2	0	1	5.8	0.68	7.1	0.84	...	...
Engineer	7.9	6	2	3	0	1	5.8	0.73	10.7	1.35	4.8	0.61
Scientist	3.3	5	5	0	0	0	4.8	1.45	...	...	...	...
Sanitarian	3.9	14	10	2	2	0	13.5	² 3.46	7.1	1.82	9.5	² 2.44
Veterinarian	1.2	3	0	2	1	0	2.9	² 2.42	7.1	² 5.92	4.8	² 4.00
Pharmacist	7.9	3	2	0	1	0	2.9	0.37	...	...	4.8	0.61
Dietitian	1.3	1	0	0	1	0	1.0	0.77	...	...	4.8	² 3.70
Therapist	2.1	2	1	1	0	0	1.9	0.90	3.6	1.71	...	...
Health services	17.2	15	7	4	3	1	14.4	0.84	14.3	0.83	14.3	0.83
Unspecified	...	14	5	6	3	0	...	...	...	...	...	...
Total	99.9	118	58	34	24	3	...	...	...	...	...	...

¹ Excludes unspecified means of death. ² Significantly associated.

Table 8. Deaths from cancer of Public Health Service Commissioned Corps members on active duty and within 12 months of retirement on disability, 1965-89

Deaths	Active duty	Retired on disability
<i>Characteristics</i>		
Number	4	12
Men	3	9
Women	1	3
Median age (years)	57	44
Age range (years)	54-58	37-67
<i>Type</i>		
Lymphoma	0	3
Breast	1	2
Colon	1	2
Central nervous system	1	1
Lung	1	0
Leukemia	0	1
Prostate	0	1
Sarcoma	0	1
Unknown primary site	0	1

the illness or injury interferes significantly with the performance of duty and if recovery of adequate functioning is not expected. Such administrative practices tend to reduce active duty mortality and affect the distribution of the types of deaths that occur.

Other factors may directly or indirectly influence the mortality rates. Low educational levels have been identified as a risk factor for death and as a potentiator of sudden death from heart disease (3, 4). In this way, professional education may facilitate longevity (5). Several studies have demon-

strated that the overall mortality of physicians is lower than that of the general population (6, 7). About one-third of Commissioned Corps members are medical officers, a factor that could reduce the overall mortality rate. In addition, officers in the Armed Forces have been reported to have a reduced mortality rate (7). The relationship between mortality and low socioeconomic status may be related to factors that can affect health, including smoking and eating habits and working conditions (7).

Except for suicide, the observed number of deaths for each major category of death was lower than expected. The higher risk of suicide was a principal finding in this study. The risk for suicide of a Commissioned Corps member may be much higher than is suggested by the ratio of the observed rate to the expected rate. The risk may be higher because applicants with risk factors for suicide are excluded. Such factors include a history of psychiatric illness or recent substance abuse. Members found to have problems that predispose them to suicide are separated from active duty. Such problems include disabling psychosis, major depression, or substance abuse leading to impaired job performance.

Combining the deaths of members and the recently retired tended to normalize the distribution of deaths, except for suicide, for which there was still an excessively high rate (table 9). The high rate may be related to the composition of the study group. Even though some early reports promulgated the belief that physicians had a high suicide

Table 9. Summary of deaths of Public Health Service Commissioned Corps members on active duty and within 12 months of retirement on disability, 1965-89

Cause	Active duty		Retired on disability		Total		Percent predicted
	Number	Percent	Number	Percent	Number	Percent	
Natural.....	22	54	22	92	44	68	70
Accidental.....	12	29	2	8	14	22	24
Suicide.....	6	15	0	...	6	8	4
Homicide.....	1	2	0	...	1	2	2
Total.....	41	100	24	100	65	100	100

Table 10. Leading causes of death for population groups

Rank	General population 1987	Active duty military 1981-82	Active duty Commissioned Corps 1965-89	Peace Corps volunteers 1962-83	Missionaries 1970-85
1	Coronary disease	Motor vehicle crash	Coronary disease	Motor vehicle crash	Motor vehicle crash
2	Malignant neoplasm	Coronary disease	Suicide	Drowning	Malignant neoplasm
3	Cerebrovascular disease	Suicide	Motor vehicle crash	Aircraft crash	Coronary disease
4	Motor vehicle crash	Aircraft crash	Malignant neoplasm	Suicide	Aircraft crash
5	Chronic obstructive pulmonary disease	Drowning	Drowning	Coronary disease	Drowning

rate (8), findings of more recent studies have tended to disprove this theory (9, 10). Our results did not demonstrate an excess number of suicides among physicians, or among nursing personnel either, although an elevated risk of death from suicide has been described for the nursing profession (11). Although our study showed an increased suicide rate among veterinarians, dietitians, and sanitarians, the number of deaths in each professional group was low and the finding must be interpreted with caution.

Peacetime deaths among members have been described. Table 10 contrasts the five leading causes of death in the general population (12), active duty military personnel (13), active duty Commissioned Corps members, Peace Corps volunteers (14), and missionaries (15). Within the military, the death rate is considerably higher for enlisted personnel than for officers (16), although a recent report described a much lower overall death rate among military personnel, compared to civilians (17). In one study of U.S. Navy personnel, only 12 percent of deaths occurred among officers, and more than half were aviators (16). In the peacetime military, private motor vehicle crashes are by far the leading cause of death, with more than three times the number of fatalities as the second leading cause, coronary disease (13). Military vehicle crashes rank seventh among causes of fatalities. Intoxication, nonuse of seat belts; and

motorcycle operator errors are considered principal contributing factors. Motor vehicle crashes are the leading cause of death among Peace Corps volunteers and missionaries, comparison groups selected for their young age, service function, wellness orientation, and health care availability.

During the course of the study, the incidence of deaths to Commissioned Corps members from motor vehicle crashes tended to remain constant, although there was a temporary decrease during the early 1980s (table 5). Analysis of fatal motor vehicle crashes among Commissioned Corps personnel in the 1980s indicated that crashes tended to occur in remote, rural areas, often where acute emergency response capabilities and care in tertiary trauma centers were unavailable.

Suicide is a major cause of mortality among active duty military personnel, Commissioned Corps members, and Peace Corps volunteers. An analysis of suicides by Commissioned Corps members in the 1980s indicated that four of the six events (67 percent) involved hardship duty, either an assignment with the Bureau of Prisons or at an Indian Health Service remote facility. Drug overdose was the principal method of suicide, a phenomenon observed for the Peace Corps as well (14). Within the general population, firearms are the primary means of suicide (18).

Drowning was among the five leading causes of death of active duty military personnel, Commis-

sioned Corps members, Peace Corps volunteers, and missionaries. Among military personnel, most drownings are thought to be associated with substance abuse (13). In general, intoxication is an established risk factor for drownings (19). Among Peace Corps volunteers and missionaries, important contributing factors are believed to be unfamiliarity with water conditions and difficulty in identifying safe and suitable recreational swimming areas. Risk factors among Commissioned Corps personnel are not known, but may parallel the Peace Corps experience, because many incidents occurred in unfamiliar locations.

The only category of deaths among Commissioned Corps members that showed a distinct increase during the study period was mortality attributable to infectious disease. Clearly, the reason was AIDS-related. Three deaths of members, as well as one of a person retired on disability, in the period 1985-89 were AIDS-related. The three deaths occurred among about 13,000 active duty personnel, assuming a median Corps strength of 5,687 during the 5-year period and an estimated annual active duty turnover rate of about 25 percent. The AIDS mortality rate of 30.8 per 100,000 is nearly six times higher than the 1987 age-adjusted AIDS death rate of 5.5 per 100,000 of the general population (12), but approximates the AIDS death rate for men 25-44 years of age for the same year, which was 27 to 35 per 100,000 (20). Reasons for the possibly higher AIDS-related death rate among Commissioned Corps members are unclear.

There was one lung cancer death during the 1980s, evidence that smoking has been uncommon in the Commissioned Corps. In comparison, in the military services, about 60 percent of enlisted persons and 25 percent of commissioned personnel are smokers (21).

We concluded that active duty status in the Commissioned Corps is associated with a reduced mortality rate. Although there is evidence that the health promotion and disease prevention role of Commissioned Corps personnel can affect mortality, as evidenced by the low number of lung cancer deaths, a disproportionate number of premature deaths, such as from unintentional injury and suicide, was attributable to preventable causes.

References.....

1. National Center for Health Statistics: Vital statistics of the United States. Vol. II, Mortality, A, 1980. DHHS Publication No. (PHS) 85-1101. Hyattsville, MD, 1985.

2. Robins, L. C., and Hall, J. H.: How to practice prospective medicine. Methodist Hospital of Indiana, Indianapolis, IN, 1970.

3. Jenkins, C. D.: Low education: a risk factor for death. *N Engl J Med* 299: 95-97, July 13, 1978.

4. Weinblatt, E., et al.: Relation of education to sudden death after myocardial infarction. *N Engl J Med* 299: 60-65, July 13, 1978.

5. Syme, S. L., and Berkman, L. F.: Social class, susceptibility and sickness. *Am J Epidemiol* 104: 1-8 (1976).

6. Williams, S. V., et al.: Mortality among physicians: a cohort study. *J Chron Dis* 24: 393-401 (1971).

7. Rimpela, A. H., et al.: Mortality of doctors: do doctors benefit from their medical knowledge? *Lancet* No. 8524: 84-86, Jan. 10, 1987.

8. Blachly, P. H., Osterud, H. T., and Josslin, R.: Suicides in professional groups. *N Engl J Med* 268: 1278-1282, June 6, 1968.

9. Roy, A.: Suicide in doctors. *Psychiatr Clin North Am* 8: 377-387 (1985).

10. Arnetz, B. B., et al.: Suicide patterns among physicians related to other academics as well as to the general population. Results from a national long-term prospective study and a retrospective study. *Acta Psychiatr Scand* 75: 139-143 (1987).

11. Katz, R. M.: Causes of death among registered nurses. *J Occupational Med* 25: 760-762 (1983).

12. Mortality patterns, United States, 1987. *MMWR* 39: 193-196, Mar. 30, 1990.

13. Beary, J. F., Walter, L. J., Jr., and Johns, J. H.: Leading causes of death for active duty military personnel. *Military Med* 149: 316-317 (1984).

14. Hargarten, S. W., and Baker, S. P.: Fatalities in the Peace Corps. A retrospective study: 1962 through 1983. *JAMA* 254: 1326-1329, Sept. 13, 1985.

15. Frame, J. D., Lange, W. R., and Frankenfield, D. L.: Mortality trends of American missionaries in Africa, 1945-1985. *Am J Trop Med Hyg.* In press.

16. Helmkamp, J. C.: A descriptive summary of active-duty deaths in the U.S. Navy in 1986. *Military Med* 153: 621-625 (1988).

17. Rothberg, J. M., Bartone, P. T., Holloway, N. C., and Marlowe, D. H.: Life and death in the U.S. Army. In *corpore sano*. *JAMA* 264: 2241-2244, Nov. 7, 1990.

18. Baker, S. P., O'Neill, B., and Karpf, R. S.: The injury fact book. Lexington Books, Lexington, MA, 1984.

19. Dietz, P. E., and Baker, S. P.: Drowning: epidemiology and prevention. *Am J Public Health* 64: 303-312 (1974).

20. Buehler, J. W., Devine, O. J., Berkelman, R. L., and Chevarley, F. M.: Impact of the human immunodeficiency virus epidemic on mortality trends in young men, United States. *Am J Public Health* 80: 1080-1086 (1990).

21. Herbold, J. R.: Smoking habits of U.S. military personnel. *Military Med* 152: 194-195 (1987).