

CANCER AND TOTAL MORTALITY AMONG ACTIVE MORMONS

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Based on Church records for 15,500 California Mormons during 1968 to 1975 and for 55,000 Utah Mormons during 1970 and 1975, the ratio of age-adjusted death rates for religiously active Mormon males compared with U. S. white males is 38% for ages 35 to 64 years and 50% for ages 35 years and above. The remaining life expectancy for active Mormon men at age 35 is about 44 years, over 7 years greater than for U. S. white males. Their standardized mortality ratio is 50% for all cancer, being 23% for smoking-related cancer sites and 68% for all other sites. Active Mormons, defined here to be High Priests and Seventies, abstain almost completely from the use of tobacco, alcohol, coffee, and tea, but appear to be fairly similar to other white males with regard to socioeconomic status, urbanization, and diet. Active Mormons are healthier than Mormons as a whole and rank among the lowest in mortality when compared with other groups of healthy males.

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THE Church of Jesus Christ of Latter-day Saints (more popularly known as the Mormon Church) has approximately 2.5 million members in the United States today and about 3.7 million members worldwide. They are located mainly in the Rocky Mountain states, particularly Utah, where they comprise about 850,000 of the state's 1.2 million population; there are almost 400,000 members in California.^{4,5} They are interesting from an epidemiologic standpoint because their "Word of Wisdom" advises against the use of tobacco, alcohol, coffee, tea, and addictive drugs.^{3,22} Also the religion recommends a well-balanced diet, particularly the use of whole grains and fresh fruits and vegetables, and moderation in the eating of meat, as well as good health habits in general. A

previous paper has examined cancer and total mortality rates among all California Mormons.⁵ The present paper will examine the cancer and total mortality rates among active Mormon males in California and Utah and discuss how they differ from the rates among Mormon males as a whole.

The Mormon Church has a lay priesthood wherein selected members volunteer their services to the Church under the direction of a central group of full-time General Authorities in Salt Lake City, Utah. The Melchizedek Priesthood includes essentially all religiously active adult male Mormons, and consists of High Priests, Seventies, and Elders. The High Priests are the local Church leaders such as bishops, patriarchs, and members of various quorums and councils; the Seventies are the adult missionaries who proselytize and attempt to convert nonmembers to the Mormon faith; the Elders are adult members who vary in their degree of activity but who generally live according to Church doctrine and participate in Church activities. High Priests and Seventies are chosen from very active Elders, usually before age 50, and they maintain one of these priesthood designations for the rest of their lives, barring unusual circumstances. No priesthood titles are given to Mormon women, so without direct questionnaire data it is difficult to identify the religiously active female members. The data presented in this paper will be limited to High Priests and Seventies, who are the active Mormons most likely to adhere to the Church-advocated lifestyle. In lieu of questionnaire data, the

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priesthood level is the best available selection criterion.

MATERIALS AND METHODS

The mortality rates determined in this paper are largely based on Mormon Church membership and death records stored in Salt Lake City, Utah. The record-keeping system has been described in detail in a previous paper.⁵ Briefly, the Church clerks throughout the world are instructed to file complete and accurate records in an annual ward report, which includes membership and death data. Both the bishop and clerk of each ward (local church) must certify that their report is complete and accurate before mailing it to Salt Lake City. The ward reports are stored in the Church Historical Department and copies of the membership statistics and death sections of these reports have been obtained for essentially all of the average 700 California wards during 1968 through 1975 and essentially all of the average 1700 Utah wards during 1970 and 1975. The only ward reports omitted are those which were not sent to Salt Lake City or were misfiled.

The procedure for analyzing this data has been described in the earlier paper, which was based on a portion of these same records.⁵ For each death listed in the ward reports, the full name and other identifying information, including sex, date and place of birth, date and place of death, and the priesthood level, have been transferred to computer cards and processed. For California, the identifying information for each deceased Mormon has been compared with the state indices which alphabetically list all deaths in California and contain equivalent identifying information. The state file number has been obtained whenever there is a match between the Mormon and state lists. Out of 6820 total Mormon male deaths, 1352 occurred among High Priests and Seventies, and 1327 (98%) of these have been confirmed with state file numbers. Additional attempts are currently being made to verify the remaining 25 deaths. Computer tape records containing death certificate information have been obtained from the California Department of Health for the 1327 confirmed deaths. The underlying cause of death for these persons was assigned by the Department of Health nosologist, using the International Classification of Diseases, Eighth Revision.⁵

For Utah, the verifying of deaths has been done in a different manner. For 1970, the 2577 Mormon male deaths have been compared with the 4005 deaths occurring among

Utah male residents in 1970, as summarized on a national mortality tape obtained from the National Center for Health Statistics (NCHS).¹⁵ Because most individual identifying information, such as, name and date and place of birth, has been removed from the NCHS tape, the matching has been done by using data which remains on the tape. Specifically, the sex, month of death, age at death, county of residence, and underlying cause of death available for each Utah death is matched with corresponding information available for most of the Mormon deaths. Since there is nearly a one-to-one correspondence in comparing 2577 Mormon male deaths with 4005 total Utah male deaths, it has been possible to make unique and unequivocal matches without name and date of birth for 1824 Mormons, including 703 of the 904 High Priests and Seventies. For the remaining 201 High Priests and Seventies who could not be unequivocally identified using this matching procedure, death certificates were requested from the Utah Department of Health in order to verify the deaths. To date, 884 (98%) of the High Priests and Seventies have been correctly identified, but the remaining 20 Church-reported deaths have not been found in the state files.

For 1975, a similar matching procedure has been used. The 2555 Mormon male deaths have been compared with the 4333 deaths occurring among Utah male residents in 1975 summarized on the NCHS national mortality tape.¹⁵ The matching for this year has been done by using sex, month and day of death, age at death, and county of residence. It has been possible to make unique and unequivocal matches for 2041 Mormons, including 814 of the 987 High Priests and Seventies. For the 173 unmatched High Priests and Seventies, death certificates were requested. To date, 972 (98%) of the High Priests and Seventies have been correctly identified, but the remaining 15 Church-reported deaths have not been found in the state files. The 1970 and 1975 Utah active Mormon male deaths have been tabulated according to cause of death as assigned by the Utah state nosologist, using the International Classification of Diseases, Eighth Revision.

The population at risk has been determined by tabulating the number of California and Utah Mormon males, by priesthood level, listed in the same annual ward reports which contained the information on deceased members. Averaged over the eight-year period, January 1, 1968 to December 31, 1975, there were about 170,000 California Mormon

males, including 11,800 High Priests and 3700 Seventies for a total of 15,500 California active Mormon males. During 1970 there were about 375,000 Utah Mormon males, including 40,900 High Priests and 9700 Seventies for a total of 50,600 active males. During 1975 there were about 410,000 Utah Mormon males, including 50,300 High Priests and 9100 Seventies for a total of 59,400 active males. The average for 1970 and 1975 was 45,600 High Priests and 9400 Seventies for a total of 55,000 Utah active Mormon males.

The age distribution of California and Utah Mormon males, by priesthood level, has been determined from the computerized Church membership files as of July 1, 1975 and September 15, 1976. In lieu of direct questionnaire data on individual Mormons, the computerized records provide the best available estimate of the Mormon age distribution. The accuracy of the computerized records is limited because a small percentage of the active members are still not included, a small percentage are included twice under different addresses, and some members are entered incorrectly. However, the records for the active members are presumably more accurate than for members as a whole, since inactive members are more likely to be in lost or unknown status. The 1975 computerized records for all members have been discussed

in an earlier paper.⁵ The 1975 and 1976 age distributions for High Priests and Seventies have been averaged and then assumed to be the actual age distribution for 15,500 active California Mormons during 1968–75 and 55,000 active Utah Mormons during 1970 and 1975. In each ten-year age group, the 1975 and 1976 distributions differ from their combined average by at most 6%, which is a reasonable estimate of the error present. The number of High Priests and Seventies at least 35 years of age averaged 13,880 in California and 50,390 in Utah. The minimum age for High Priests and Seventies is 19 years and their median age is 50 years in California and 56 years in Utah. Although race is not recorded in the membership records, these active Mormons can be considered to be all white; evidence for this is the fact that more than 99% of their deaths occur among whites. The assumption that average 1975–76 age distributions are the same as 1968–75 and 1970,75 age distributions is reasonable because the active Mormon populations have not been subject to any abnormal influx or outgo of members over this time period, although they have grown steadily by about 25%. Furthermore, the age distribution of active California Mormon deaths has remained statistically unchanged from 1968 to 1975, indicating that the age distribution of the population at risk is

TABLE 1. Annual Age-Specific Total Death Rates and Life Expectancy for Active Mormon Males and Several Comparison Male Populations (deaths/1000)

Age (years)	1945–74 California Muir active Mormon males	1968–75 California active Mormon males	1970,75 Utah active Mormon males	1960–65 ACS cohort “never smoked regularly” males	1966–68 NCHS U. S. sample “never smoked cigarettes” white males		1970 Utah white males	1970 California white males	1970 United States white males
					1970	1970			
35–44	1.55 (1)*	1.18 (35)	1.21 (23)	1.7†	2.14	3.09	3.33	3.44	
45–54	3.57 (7)	3.39 (110)	3.12 (78)	3.6†	5.68	8.39	8.25	8.83	
55–64	9.67 (28)	8.20 (208)	9.25 (228)	11.†	16.76	18.12	20.64	22.03	
65–74	30.82 (77)	22.55 (351)	25.61 (505)	31.†	36.41	44.25	45.60	48.10	
75–84	75.09 (89)	61.66 (405)	68.83 (686)	75.†	94.98	88.46	97.25	100.99	
85+	145.0‡ (40)	151.20 (206)	139.44 (328)	145.†	150.0§	157.74	176.25	185.52	
35–64	4.19 (36)	3.62 (353)	3.79 (329)	4.58	6.86	8.52	9.17	9.74	
35+	11.35 (242)	9.36 (1315)	10.09 (1849)	11.69	15.12	17.21	18.41	19.41	
e ₃₅ (years)*	42.8	44.6	44.0	42.4	39.6	37.9	37.1	36.5	

* Number of deaths upon which rate is based.

† Estimated death rates based on published values for proportion dying in each age interval.⁹

‡ Estimated death rate based on proportion dying between ages 85 and 90 years.

§ Assumed death rate based on comparison with ACS cohort.⁹

^{||} Age-adjusted by the direct method to the 1940 United States population within the stated age interval.^{16,20}

* Life expectancy (average remaining lifetime) in years at age 35, calculated by standard abridged life table method.^{2,18}

probably unchanged. However, the 1975-76 age distributions may contain some as yet undetermined systematic error and thus they must be qualified as the best currently available.

RESULTS

Active Mormon age-specific death rates in California from 1968 to 1975 and in Utah during 1970 and 1975 have been calculated for all cancer and all causes by combining the deaths and population at risk as determined above. For those at least 35 years of age, the rates and the number of deaths upon which they are based are given in Table 1 for all causes of death and in Table 2 for all cancer. (The population at risk can be obtained by dividing the annual deaths by the death rate.) In Table 1 life expectancy at age 35 has been calculated from the death rates using the standard method for an abridged life table.^{2,18} Also included are age-adjusted death rates, standardized by the direct method¹⁸ to the total 1940 U. S. population, which is the reference population used by the National Center for Health Statistics.²¹ A more recent standard population would increase all the age-adjusted rates slightly in absolute value but not in relative value.

For comparison with Mormons, death rates for the following groups have been presented in Tables 1 and 2: 1970 United States, California, and Utah white males,^{1,15,21} 1966-68 National Mortality Survey of U. S. white males who never smoked cigarettes,^{7,13,14} and 1960-65 American Cancer Society prospective study of specially selected males from 25 states who never smoked regularly.⁹ The National Mortality Survey^{7,13,14} was a strati-

fied random sample of 1966-68 U. S. deaths and is based on information obtained from death certificates and from questionnaires mailed to death record informants. This survey was conducted by the National Center for Health Statistics (NCHS) and was designed primarily to provide information on the smoking habits of decedents, along with certain socioeconomic and demographic information. The final sample of 19,526 comprised 1/260 of all deaths which occurred among persons 35 to 84 years of age in 1966-68. Mortality rates have been calculated as a function of cigarette smoking status using population estimates based on an August 1967 survey of U. S. cigarette smoking habits conducted by the NCHS.⁷ The age-specific death rates for an estimated 9,525,000 U. S. white males who never smoked cigarettes are already available⁷ and cancer death rates have been calculated from these same sources,^{7,14} which detail the survey methodology. An extensive presentation of results is to be published elsewhere.⁶ The American Cancer Society (ACS) prospective study followed a cohort of 440,558 men and 562,671 women who were enrolled between October 1959 and February 1960 by 68,116 ACS volunteer workers.⁹ The study area included 1,121 counties of all sizes and types in 25 states (California was included but Utah was not), and the enrollees were essentially all white, not seriously ill, and generally above average in socioeconomic status. Mortality data are presented on the 95,849 males who never smoked regularly and were followed from July 1, 1960 to June 30, 1965. Age-specific death rates have been estimated from the stated proportion dying within 5-year age intervals.^{9,18}

TABLE 2. Annual Age-Specific Cancer Death Rates for Active Mormon Males and Several Comparison Male Populations (deaths/1000)

Age (years)	1968-75 California active Mormon males	1970,75 Utah active Mormon males	1966-68 NCHS U. S. sample "never smoked cigarettes" white males	1969-71 Utah white males	1970 California white males	1970 United States white males
35-44	.34 (10)	.21 (4)	.31	.31	.51	.50
45-54	.83 (27)	.72 (18)	.79	1.03	1.60	1.72
55-64	1.66 (42)	1.30 (32)	3.10	3.27	4.71	4.98
65-74	4.43 (69)	4.67 (92)	6.64	8.02	9.86	9.97
75-84	11.42 (75)	11.84 (118)	13.84	13.08	16.02	15.93
85+	13.95 (19)	8.93 (21)	14.0*	13.26	18.95	17.72
35-64†	.82 (79)	.65 (54)	1.14	1.27	1.89	1.99
35+†	1.80 (242)	1.66 (285)	2.43	2.66	3.56	3.65

* Assumed death rate based on comparison with United States population within the stated age interval (16,20).

† Age-adjusted by the direct method to the 1940

Table 1 reveals that the ratio of age-adjusted total death rates for active Mormon males compared with U. S. white males is 38% for ages 35 to 64 years and 50% for ages 35 years and above. The ratio for U. S. white males who never smoked cigarettes compared with all U. S. white males is 70% for ages 35 to 64 years and 78% for ages 35 years and above. The remaining life expectancy for active Mormon men at age 35 is about 44 years, which compares with 36.5 years for all U. S. white males and 39.6 years for U. S. white males who never smoked cigarettes. The ACS males who never smoked regularly have a remaining life expectancy of 42.4 years, which theoretically reduces to about 39.5 years once a correction has been made for the beneficial effects of the method by which they were selected.⁹

For active Mormon males the standardized mortality ratio (SMR) based on observed and expected mortality is presented in Table 3 for 16 major cancer sites and site groupings, as well as for all cancer. The expected numbers of deaths are determined by multiplying the

population at risk by the 1970 age-specific cancer death rates for U. S. white males and summing over all age groups at least 35 years old. By definition, the SMR for 1970 U. S. white males is 100%. For both Utah and California Mormons the SMR is consistently less than 100% for almost every site. For the combined smoking-related cancer sites of the buccal cavity and pharynx, esophagus, lung, and bladder, the SMR is 26% in California, 20% in Utah, and 23% in both states combined. For all other cancer sites the SMR is 67% in California, and 69% in Utah, and 68% in both states. For all cancer the SMR is 50% in California (based on 242 observed deaths), 50% in Utah (based on 285 observed deaths), and 50% in both states. All these SMR values are significantly less than 100% ($p < .001$), assuming Poisson statistical variation.² The SMR values for individual sites have not been tested for statistically significant differences because of the small number of observed deaths, but the SMR values are substantially less than 100% for the sites of colon, rectum, liver, pancreas, and kidney, as well as for

TABLE 3. Standardized Mortality Ratios Based on Observed and Expected Cancer Deaths at least 35 Years of Age for California and Utah Active Mormon Males and the 1966-68 NCHS U. S. Sample of White Males who Never Smoked Cigarettes

Cancer site	ICD number (8th revision)	Standardized mortality ratios		
		1968-75 California active Mormon males (≥35 years)	1970,75 Utah active Mormon males (≥35 years)	1966-68 NCHS U. S. sample "never smoked cigarettes" white males (35-84 years)
Buccal cavity and pharynx	(140-149)	13 (2)	6 (1)	63 (56)
Esophagus	(150)	0 (0)	40 (5)	57 (37)
Stomach	(151)	75 (19)	84 (26)	98 (17)
Large intestine (colon)	(153)	74 (34)	56 (32)	122 (44)
Rectum	(154)	37 (6)	50 (10)	149 (18)
Liver, gallbladder, biliary passages	(155-156, 197.7-197.8)	41 (6)	34 (6)	74 (6)
Pancreas	(157)	47 (13)	72 (24)	54 (9)
Lung, bronchus, trachea	(162)	23 (34)	19 (32)	19 (108)
Prostate	(185)	79 (35)	107 (66)	88 (276)
Bladder	(188)	73 (13)	22 (5)	59 (6)
Kidney	(189.0-189.1)	19 (2)	48 (6)	73 (7)
Nervous system	(191-192)	65 (7)	65 (7)	85 (10)
Lymphomas	(200-202)	100 (18)	70 (14)	78 (14)
Leukemia	(204-207)	103 (19)	80 (18)	57 (12)
All other sites (not given above)		59 (34)	50 (33)	125 (50)
Smoking-related cancer sites	(140-150, 162, 188)	26(49)	20 (43)	29 (207)
Non-smoking-related cancer sites	(151-209, excluding 162, 188)	67 (193)	69 (242)	98 (463)
All cancer (malignant neoplasms)	(140-209)	50 (242)	50 (285)	71 (670)

Numbers in parentheses represent total observed deaths for Mormons and unweighted sample deaths for NCHS cohort. Expected deaths were calculated by the

indirect method using 1970 U. S. white male rates. The standardized mortality ratio is 100 when observed and expected deaths are equal.

buccal cavity and pharynx, esophagus, lung, and bladder.

For comparison with other nonsmokers, data based on the National Mortality Survey of U. S. white males aged 35 to 84 years who never smoked cigarettes^{7,14} are presented in Table 2 as age-specific cancer death rates and in Table 3 as site-specific SMR values. These SMR values are fairly consistent with the Mormon values for the smoking-related cancer sites of lung and bladder, but are significantly higher for other cancer sites, particularly colorectal cancer. The SMR is 29% for the smoking-related sites, 98% for the nonsmoking-related sites, and 71% for all sites combined.

Since the Mormon mortality rates are based entirely on Church records, using available death and population-at-risk data, it is important to confirm these mortality rates for a well-defined cohort of individually identified Mormons. For this purpose use has been made of a historical biographical book written around 1950 by Leo J. Muir about active California Mormons of that era.¹² For each Mormon who is included, this book gives demographic information, including full name, date and place of birth, parents' names, occupation, and residence, and allows a Church-independent historical prospective determination of mortality during the past thirty years. Listed in the book are 426 males who were alive and at least 35 years of age as of January 1, 1945. These persons, the majority of whom lived in Los Angeles County, have been followed individually in order to determine their current vital status. All of them have been positively assessed as being either alive or dead as of January 1, 1975.

The following procedures have been used to identify 242 deceased members: four separate searches of the deceased membership file maintained since 1942 by the Mormon Church in Salt Lake City located 227 deaths; personal contact with members of the cohort families and other Church leaders in Los Angeles County, along with a thorough search of the California state death indices for all members of uncertain status located 15 additional deaths. Verification of death status has been done by obtaining 240 death certificate copies; the remaining two deaths occurred in foreign countries according to the Church deceased file.

The following procedures have been used to identify 184 living members: four separate searches of the living membership files (both the computerized file and the card file) of the Mormon Church identified 183 persons;

personal contact with cohort members and Church leaders in Los Angeles County identified 127 persons; a check with the Department of Motor Vehicles for the existence of a California driver's license located 137 persons as of 1970 or later. A thorough search of annual California state death indices from 1970 through 1974 yielded no deaths among cohort members believed to be alive from the other sources. Verification of living status is based on the fact that these members have a specific address as of January 1, 1975 or later which agrees with information obtained from at least two of the following independent sources: telephone directories, Church membership records, Department of Motor Vehicle records, or information from local Church leaders. Because of the consistency and overlapping comprehensiveness of the various sources it has been considered necessary to make direct contact with only those individuals with major uncertainty in their status.

Since the vital status of all the members of the cohort has been ascertained and verified over a thirty-year time period, there is no loss to follow-up. This gives an indication of the epidemiologic value of the Mormon records and of the potential for long-term follow-up of active Mormons. A cohort life table analysis has been done by accumulating deaths and person-years between exact five-year age intervals from 35 years through 100 years. Probabilities of death, age-specific death rates, and life expectancy have been calculated using standard procedures for abridged life tables^{2,18}; selected results are presented in Table 1. Using the 1940 U. S. population as the standard, the 1945-74 Muir cohort has an age-adjusted mortality rate for males at least 35 years of age of 11.35 deaths per 1000, which is 21% higher than the rate of 9.36 for 1968-75 active California Mormon males and 12% higher than the rate of 10.09 for 1970,75 active Utah Mormon males. However, within the 95% confidence interval of Poisson statistical variation, the Muir age-specific death rates are consistent with all the corresponding Utah rates and with all the California rates except those between 65 and 84 years of age. The Muir rates could be expected to be somewhat higher than rates centered around 1970 because they occurred over the years 1945 through 1974, a time period during which the age-adjusted U. S. white male death rate declined by 18%.^{16,20} The Muir males were initially selected without knowing their priesthood status, but they have since been determined to be active Mormons in the sense that about 90% of deceased males were High

Priests and 5% were Seventies, according to the Church death records. Given the time period and selection differences, it appears that there is generally good agreement between the Church-based mortality rates and the independently derived Muir rates. Any systematic error in the Church-based rates appears to be at most about 10%.

Limited data on Mormon habits comes from the results of a 1965 "Health and Ways of Living" survey and subsequent 1974 resurvey of a probability sample of 6,928 adult residents of Alameda County, California, conducted by the Human Population Laboratory of the California State Department of Health.^{5,10} Included in the survey were 19 active Mormon males out of a total of 48 Mormon males, where the active Mormons here are defined to be those who attended church every week. The 1965 and 1974 surveys showed that none of the active Mormon males currently used tobacco or alcohol, although there were 31% former smokers among this group. Another estimate of Mormon health habits comes from a 1975 mail questionnaire sent to a small sample of 18 active Mormon males in West Los Angeles, who were High Priests, Seventies, or Elders and who attended church every week. This sample showed essentially no current use of tobacco, alcohol, coffee, tea, cola drinks or nonprescription drugs. Their diet appeared to be well balanced and moderate. Almost all these Mormons ate meat, fish, poultry, and eggs, as well as whole grains, fresh fruits, and vegetables; about 70% used vitamin pills. Precise comparisons of health habits and dietary intake between active Mormons and the general population are not possible because the questionnaire data is approximate, not confirmed by direct interview, and based on very small and not necessarily representative samples of active Mormons. However, active Mormon males appear to be living according to the "Word of Wisdom," based on the data obtained thus far.

It is useful to discuss available data on other demographic characteristics. Since questionnaire data has been collected on only a tiny part of the population at risk, existing information about the population at risk and deaths will be used. Active Mormon males are distributed throughout the urban and rural portions of California in a pattern similar to that for all white males, in the sense that the percentage of active Mormon males in each county is consistent with the statewide average of 0.17% in 1970. The distribution by socio-economic status, defined to be the last occupation as indicated on the death certificate, is

TABLE 4. Occupational Distribution of Active Mormon Males and all White Males at least 35 Years of Age in California who Died in 1970, Using the Group Assigned for Last Occupation as Given on Death Certificate

Occupational group	1970	1970
	California active Mormon males (≥35 years)	California white males (≥35 years)
Professional workers	10.9% (16)	9.1%
Technical and administrative workers and managers	25.2 (37)	20.1
Clerical and sales workers	17.7 (26)	12.9
Skilled workers	23.8 (35)	24.3
Semiskilled workers and mine laborers	9.5 (14)	15.5
Laborers except farm and mine	6.1 (9)	10.2
Farm laborers and foremen	0.7 (1)	2.4
Farmers and farm managers	4.8 (7)	4.3
Other and unknown	1.4 (2)	1.2

Number of Mormon deaths given in parentheses.

shown in Table 4 for 1970 California active Mormon male deaths and all 1970 California white male deaths. There are no significant differences in any of the categories between active Mormons and all white males, although there is somewhat greater concentration of active Mormons in the higher socio-economic classes. Also, there are no significant differences between the active Mormon male deaths and all white male deaths in California in the distribution of types of facilities where the deaths occurred, in the autopsy status of the deaths, or in the type of person certifying the deaths. About 57% of the deaths occurred in private hospitals, with most of the remaining deaths occurring in nursing homes, county or other hospitals, and at home. About 30% of the deaths had an autopsy, and only about 25% had autopsies where the findings were used in assigning the underlying cause of death. Physicians certified about 96% of the deaths. These comparisons give some indirect evidence that the active Mormons received medical care similar to that of other white males, at least at the time of death.

Analyzing place of birth of the deceased at least 35 years of age shows that in California, 46% of the deceased active Mormons were born in Utah; in Utah, 75% of the deceased active Mormons were born in Utah. The high percentage of Utah active Mormon males who were born and died in Utah is a good indication that most of these men have been Mormons since birth, whereas the lower percent-

age of California active Mormon males who were born in Utah indicates that possibly half of these men were converts to the Mormon Church. This assumes that birth in Utah is synonymous with being Mormon, which is a reasonable approximation since about 70% of all American Mormons were born in and lived in Utah around the time these men were born. For comparison, 69% of all the California Muir males were born in Utah and 70% of the deceased Muir males were born in Utah, indicating that many early California Mormons were lifetime members who migrated to California from Utah.

DISCUSSION

The results presented here indicate that active Mormon males in both California and Utah have cancer and total mortality rates which are about half the corresponding rates among U. S. white males and substantially less than the rates for Mormon males as a whole. The cancer death rates for all California Mormons during 1970-72 are presented in an earlier publication⁵ and rates during 1968-75 are to be presented elsewhere. The earlier paper considered three possible age distributions for California Mormons: the California state distribution, the Utah state distribution, and the "modified" distribution. Based on the 1975 and 1976 Church computerized membership files, it appears that the "modified" age distribution is the most accurate, and this yields an SMR of about 65% for all California Mormon males.

For comparative purposes, inactive Mormon males can be defined by subtracting active Mormons (High Priests and Seventies) from the total. This is an arbitrary division done in lieu of better criteria. Referring to the Table 3 data on active California Mormon males and the published data on all California Mormon males, it is possible to arrive at the following approximate SMR values for total cancer: 50% for active Mormons, 72% for inactive Mormons, and 65% for all Mormons. For the smoking-related cancer sites the approximate SMR values are: 26% for active Mormons, 73% for inactive Mormons, and 58% for all Mormons. For the nonsmoking-related cancer sites, the approximate SMR values are: 67% for active Mormons, 70% for inactive Mormons, and 68% for all Mormons. These comparisons indicate that most of the mortality difference between active and inactive Mormons occurs in the smoking-related cancer sites. This is consistent with the limited available data indicating that active

Mormons avoid smoking and drinking almost entirely, whereas inactive Mormons tend to smoke and drink about as much as the general population.⁵ The SMR for nonsmoking-related cancer sites appears to be uniformly low for both active and inactive Mormons.

The active Mormon males have SMR values which are lower than those for other previously studied groups of nonsmokers, such as the NCHS sample and the ACS cohort. This suggests that lack of smoking cannot account for all of the differences being observed between the active Mormons and the general population. At this time it is not possible to determine precisely how much of the difference is related to smoking per se, since nonsmokers differ from smokers in many ways.¹⁹ Furthermore, nonsmokers may be similar to active Mormons in many respects besides smoking status. Besides the nonsmoking cohorts already compared in Tables 1 and 2, other nonsmoking cohorts are discussed elsewhere.^{8,19} In addition, Seventh-day Adventists provide an interesting comparison because this religious group forbids the use of tobacco, alcohol, coffee, and tea, as well as advocating a lacto-ovo-vegetarian diet.¹⁷ California Adventist men have an SMR of 53% for cancer and 54% for all causes based on 1958-65 mortality data.¹⁷ Protestant clergymen, who have been shown in one study to have an SMR of 60% for all cancer and 72% for all causes,¹¹ constitute another low-risk religious group, but one without well-defined health-related characteristics. These data suggest that certain lifestyles are associated with extremely low death rates, but the exact reasons for this are not yet clear.

Before drawing any final conclusions about the active Mormon mortality rates it is important to review the indications that they are essentially correct. First, the accuracy of the deaths listed in the Church ward reports has been established by the fact that 98% of the deaths have been verified with official state records. Second, the completeness of the deaths listed in the 1968-75 California ward reports has been established by the fact that 52 of 54 California deaths which occurred among the Muir males during 1968-74 were listed in these reports. Third, the separate 1975 and 1976 Church computer tabulations of the active Mormon age distribution appear to be quite consistent with one another and they constitute a reasonable approximation of the age distribution back to 1968. However, any overall systematic error in the Church computerized records would not be obvious without additional checking and the age distribution re-

mains the weakest part of the death rate calculations. Fourth, the independently-derived death rates for the Muir active Mormon males agree with the Church-based death rates for active Mormon males to within 10%. These are good indications that the Church record-keeping system is quite complete and accurate, particularly for active members. Other checks on the quality of Mormon records for members as a whole have previously been made and they also indicate that there are no serious errors.⁵

The importance of these results lies in the fact that the cancer and total mortality rates for active Mormon males are among the lowest of all previously reported cohorts in the United States. Furthermore, the earlier cohort studies have involved specially selected questionnaire respondents who, as a whole, were healthier than average U. S. white males. For instance, these studies typically enrolled persons with above-average socioeconomic status, excluded seriously ill persons, and may not have traced all deaths.¹⁹ These factors alone tend automatically to lower observed death rates. The Mormon mortality data, on the other hand, have been collected in a census

survey manner based on overall Church membership and death records. Although active Mormons are a selected population in a sense that they are leaders of a religious group, they are not "questionnaire respondents" as in other cohort studies. In addition, active Mormons appear to be about average in socioeconomic status and similar to non-Mormon whites in several demographic respects.

It remains to be determined exactly what components of the active Mormon lifestyle are related to their low mortality rates. It appears that the mortality differences are only partially explained by lack of smoking. Several additional factors are possibly important: low consumption of alcohol, coffee, tea, soft drinks, and drugs; certain dietary habits; general health practices, including exercise and proper sleep and weight; various social and psychological aspects connected with the nature of their religion; selection factors related to obtaining leadership roles in the Church; and heredity. It is hoped that further study will result in a better understanding of the factors which are responsible for reducing mortality from cancer and other diseases.

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