



Cancer in Utah Mormons and Non-Mormons

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In this paper we review our studies on cancer in Utah and in Mormons and non-Mormons in Utah. We first discuss the methods and resources used and then findings from the various studies. We review cancer comparisons of Utah to the United States, Mormons to non-Mormons in Utah, urban to rural residence in Mormons and non-Mormons, and active to inactive Mormons in Utah. We conclude by presenting data from our survey studies of cancer risk factors in Utah.

Methods and Resources

The Utah Cancer Registry

Our studies on cancer in Mormons begin with the Utah Cancer Registry, which was established in 1968 by Dr. Charles Smart. The registry was formed by consolidation of the major Utah hospital tumor registries (many having data from the mid-1950s) with expansion to the entire population of Utah as of January 1, 1968. Cancer cases are reported to the registry by each hospital in Utah. The hospital record-rooms clerk review discharge summaries of each hospital admission, and whenever cancer is mentioned a registry abstract of the medical record is completed and forwarded. In addition, both radiation therapy units in the state and several of

the offices of physicians with large cancer practices send abstracts to the registry. The state registrar also forwards to the registry a copy of each death certificate which mentions cancer. On an annual basis the log books of each of the 20 pathology laboratories serving Utah are reviewed to identify any additional cases. A final step in obtaining complete cancer reporting is the routine search for Utah residents of the cancer registries of the surrounding states (covering Idaho, Wyoming, New Mexico, and parts of Montana, Colorado, Nevada, and Arizona); Utah residents found are added to the Utah Cancer Registry.

One of the best measures for determining the completeness of a cancer registry reporting system is called the Death Certificate Only reporting rate. This is the percent of cases reported only from death certificates and having no hospital or physician information. A good registry will have a Death Certificate Only rate less than 5 percent. For the Utah Cancer Registry, it has been in the range of 2-4 percent since the registry began in 1968.

Diagnostic information carried by the registry includes name, date, age, hospital, and residence at diagnosis and cancer site, stage, and histology, with copies of the discharge summaries, operative reports, and pathologic reports

routinely obtained. The proportion of the cases with histologic confirmation of diagnosis varies by site, with an average of 94 percent.

The Utah Cancer Registry maintains an active follow-up system to keep track of each cancer patient from the time of diagnosis until death. Follow-up letters are sent at least annually to physicians and hospitals requesting information on each patient, including vital status, treatment methods, etc. Registered patients are checked annually with the Utah death certificate files to determine those who have died during the year. Follow-up rates for the Utah Cancer Registry are greater than 90 percent (proportion of patients known dead or with living status verified during the past two years).

In 1973 the Utah Cancer Registry became part of the National Cancer Institute's Surveillance, Epidemiology and End Results (SEER) Program. This national program consists of ten population-based cancer registries located across the country, which cover about 10 percent of the nation's population. Data from the Utah Cancer Registry are reported annually to the National Cancer Institute as part of this system of national cancer surveillance. The SEER program provides careful data control procedures to monitor and maintain data quality. Dr. Joseph Lyon

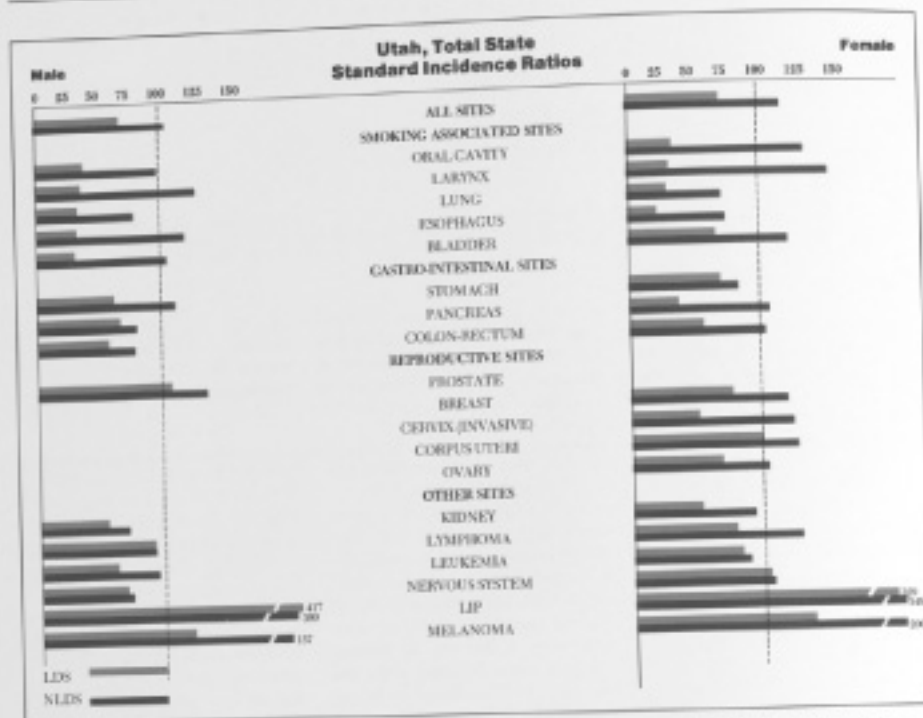


Figure 1: Standard incidence ratios for selected cancer sites by religion and sex, Utah 1967-75. 100 percent = Third National Cancer Survey white rates.

Table 1. Utah's ranking in cancer mortality by site for the white population of the United States, 1950-1980, by sex (Utah's percent difference from U.S. rate)

Rank*	Males		Females	
1-3	Esophagus (-62%) Nasopharynx (-39%) Larynx (-35%)	Lung (-42%) Liver/Biliary (-39%) Pancreas (-35%)	Esophagus (-75%) Nasopharynx (-75%) Larynx (-54%) Lung (-45%) Mouth (-45%)	Skin (-37%) Colon (-34%) Cervix (-34%) Pancreas (-33%)
4-12	Rectum (-44%) Mouth (-43%) Colon (-34%) Bone (-34%) Kidney (-32%)	Testis (-37%) Bladder (-36%) Non-Skin (-35%) Leukemia (-7%)	Rectum (-39%) Bladder (-34%) Bladder (-37%) Bone (-30%)	Kidney (-33%) Ovary (-21%) Cerv. Tis. (-17%) Eye (-16%)
13-26	Bladder (-25%) Stomach (-12%) Lymphoma (-9%) Melanoma (0%)	Skin (-7%) Salivary (-3%) Cerv. Tis. (-3%) Lip (+9%)	Esoph. (-10%) Liver/Biliary (-10%) Lymphoma (-14%) Uterus (-14%)	Melanoma (-10%) Stomach (-9%) Leukemia (-4%)
27-47	Endomet. (0%) Eye (+4%) Brain (+4%) Prostate (+10%)	Breast (+14%) Myeloma (+10%) Thyroid (+23%)	Thyroid (+3%) Myeloma (+8%) Endomet. (+10%)	Brain (+13%) Nose/Sin. (+17%) Salivary (+23%)

*lowest state = 1, highest = 49 (includes District of Columbia) —data from reference 2.

from the University of Utah School of Medicine has been codirector of the Utah Cancer Registry since 1973, and he and Dr. Straet are coprincipal investigators of the National Cancer Institute contract which supports the Utah Cancer Registry.

Classification by Church Membership

In the early 1970s after extensive checking, editing, and verification of cancer registry data for the five-year period 1966-1970, arrangements were made with the Church Membership Department to obtain fact of membership on each of the 10,641 patients registered during that period. The name and other identifying information on each cancer patient was used to search the central membership records to identify whether that individual was an LDS Church member. This was conducted by the department employees. Matching of membership records with cancer-registry records was performed using first, last, and middle names, county of residence, and, when available, date of birth and parent and spouse information. All patients who were found in the membership records were classified as LDS Church members. To verify the completeness of the LDS membership classification, each of the deceased cancer patients (4,700) was located in the Utah obituary notices (available on microfilm files). Obituaries nearly always contain information regarding church affiliation. About 1 percent of individuals who had a Church membership record were reported in the obituary as belonging to another church. In order to be conserva-

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ative in our studies, we classified as an LDS Church member each patient who either had a central membership record or was listed in the obituary as a member of the Church.

This process was repeated during the late 1970s for the cancer registry data from 1971-1975. At that time the central membership records for Utah had been computerized, and the computer search was much easier than the original search of the manual membership file. Special approval was again obtained, since it is current policy that these records be restricted to Church use. Obituaries were also searched in the same manner for this data set. At this point we had identified over 20,000 Utah cancer patients diagnosed during the years 1966-1975, and had classified each as to membership in the Church.

Utah and LDS Population Data

Population estimates for LDS Church members in Utah were obtained from published annual Church membership reports. These provided the total number of Utah Church members by sex, but not by age or county of residence. Age and residence data were obtained for the 1966-1970 analysis from a 5 percent systematic sample drawn from the central membership file in 1971. This sample was drawn for the purposes of projecting Church growth, and with special approval we were able to obtain the data and have them rearranged by county boundaries for Utah. We used five-year age groups through age 75 and over. In 1976 after the central membership records for Utah were computerized, we obtained from the Church Membership Department total population counts of Utah members by county of residence, age, sex, and priest-hood office. These age and residence distributions were applied to the total LDS populations obtained from the annual membership reports for the mid-point years of each data set.

Population data for the state of Utah were obtained from the U.S. census reports for 1960 and 1970 and from 1975 population estimate obtained from the Utah Bureau of Health Statistics.

Population estimates for non-LDS population of Utah were obtained by subtracting the LDS population estimates from the total state populations within each age, sex, and county category, respectively.

Findings

Utah vs U.S. Cancer Comparisons

We compared Utah cancer incidence with that in the United States Third National Cancer Survey, which was conducted by the National Cancer Institute for the years 1969-1971 and covered about 10 percent of the U.S. population. We compared Utah cancer incidence rates for 1966-1970 with those from the cancer survey white population. We also compared Utah cancer mortality rates during the same period with those for the white U.S. population (1). Utah cancer mortality data were obtained from the Utah Bureau of Health Statistics using death certificate enumerations.

The racial composition of the Utah population is important to consider because of the known differences in cancer incidence by race. More than 97 percent of the population of Utah are white, with about half of the remainder being of American Indian extraction. Blacks comprise less than 1 percent of Utah's population. All of our cancer comparisons are therefore with the white U.S. population.

In 1974 the National Cancer Institute published age-standardized cancer mortality data by race and sex for each state and county in the United States during the period 1950-1980 (2). A comparison of Utah versus U.S. white cancer mortality rates are given in Table 1. Rankings are given for the 48 continental states and District of Columbia, with the state having the lowest mortality rate being ranked as one and the highest ranked 49.

Utah has the lowest overall cancer mortality of the 49 areas both for white males and white females. As can be seen in Table 1, most of the cancer sites where Utah ranks the lowest are those related to the use of tobacco and alco-

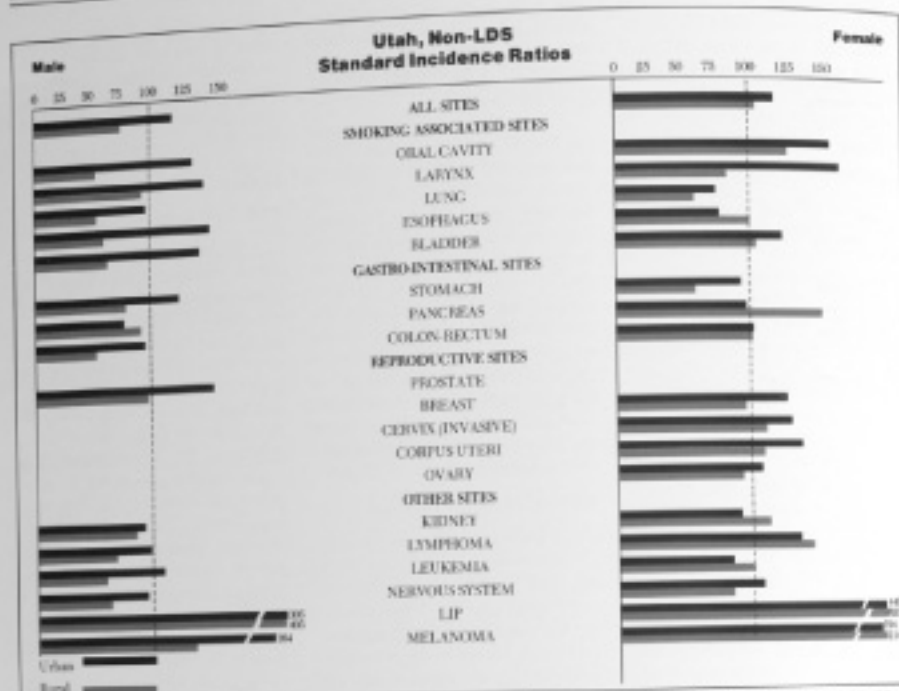


Figure 2: Standard incidence ratios for selected cancer sites by residence and sex, Utah non-Mormons 1967-75. 100 percent = Third National Cancer Survey white rates.

Table 2. Standardized cancer incidence (SIR) and mortality (SMR) ratios for selected sites in Utah (a).

Site	Sex	SIR (b)	SMR (c)
All Sites (excluding skin cancer)	M	79	75
	F	78	78
Smoking related sites (d)	M	59	47
	F	54	43
Lip	M	309	-
	F	309	-
Pancreas	M	64	80
	F	64	85
Colon	M	69	69
	F	72	73
Rectum (e)	M	34	58
	F	38	68
Breast	F	88	78
	F	77	82
Uterine Cervix	F	26	55

(a) $p < .01$ for each SIR listed; data from reference 1.

(b) 1966-1970 observed incidence from Utah Cancer Registry, with expected values derived from the Third National Cancer Survey, white rates, 1966-1971.

(c) 1966-1970 observed mortality from Utah Vital Statistics, with expected values derived from USA white mortality rates, 1968.

(d) Includes oral cavity and pharynx, larynx, esophagus, lung and urinary bladder.

(e) Coding differences at these sites between classifications used for incidence and mortality data make the SIRs and SMRs only approximately comparable.

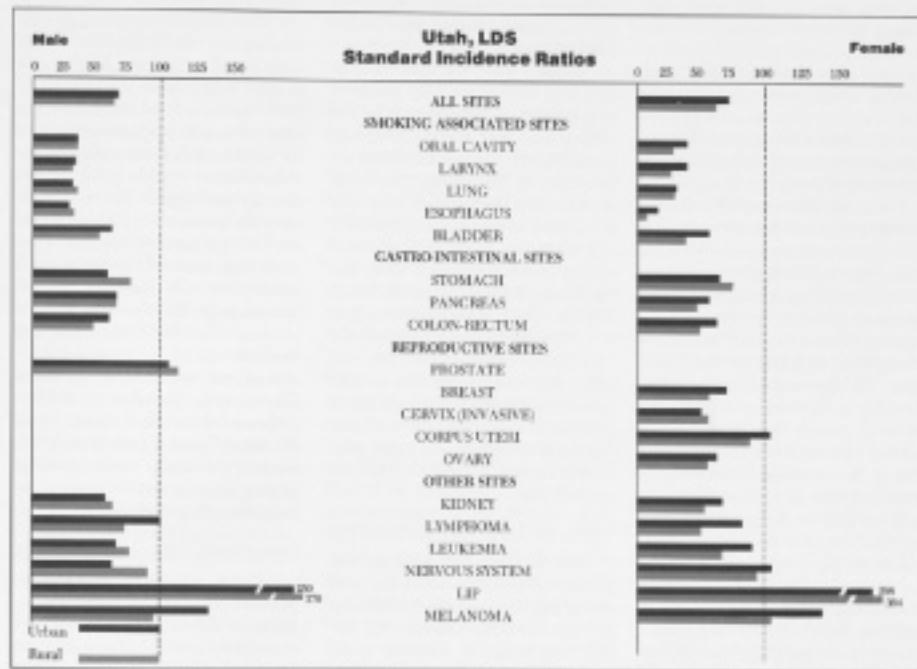


Figure 3: Standard incidence ratios for selected cancer sites by residence and sex, Utah Mormons 1967-75. 100 percent = Third National Cancer Survey white rates.

Table 3. Characteristics of Utahs by religion and LDS Church activity, males (data from reference 12).

Factor	Non-LDS	LDS			
		Total	Active	Partly Active	Inactive
Distribution (%)	28	72	40	30	21
Education					
< HS (%)	23	16	7	21	30
HS (%)	26	21	20	35	29
< COLL (%)	30	36	37	40	26
COLL+ (%)	21	27	36	21	15
Smoking					
Current (%)	35	10	1	13	27
Ever (%)	78	40	23	44	71
Alcohol Use					
Current (%)	64	18	6	12	44
Marital Status					
Single (%)	10	2	2	0	4
Married (%)	63	63	67	80	76
Div/Sep (%)	5	2	0	0	6
Widowed (%)	4	4	1	1	13
Avg. Age at First Marriage	23	23	23	24	22
< 1 Marriage (%)	37	13	13	8	21

hol (lung, larynx, pharynx, mouth, esophagus, and urinary bladder). (3) Cancer of the pancreas has been related to smoking and to coffee and alcohol drinking in some studies, and cancers of the kidney, stomach, and cervix have recently been added to the list of smoking-associated cancers (4,5). Cancers of the mouth, pharynx, larynx, esophagus, and liver are associated with alcohol use (6). Cancer of the colon-rectum is low in Utah, as are cancers of the bone, testis, ovary, and Hodgkin's lymphoma.

We used age-standardized ratios (given as percents) to express comparisons of cancer incidence and mortality in Utah with that in the United States. The Standardized Incidence Ratio (SIR) is the number of cases observed to occur in Utah divided by the number expected if the Third National Cancer Survey white incidence rates were applied to the Utah population in each age and sex category. This is an age-adjusted ratio of the Utah incidence rate to the Third National Cancer Survey white rate. The Standard Mortality Ratio (SMR) is the number of deaths occurring in Utah divided by the number expected if the United States white mortality rates were applied to the Utah population in each age and sex category.

As shown in Table 2, cancer incidence and mortality rates in Utah during 1966-1970 were about half of the national rates at the smoking-related sites in both sexes. Cancer of the lip had an incidence much higher than the national rate, but no deaths were reported during this period. Incidence and mortality of cancers of the pancreas, colon-rectum, and female breast, ovary, and uterine cervix were also low in the Utah population. The low cancer incidence rates were consistent in all age groups.

LDS vs Non-LDS Cancer Comparisons

After comparing cancer incidence and mortality in Utah with that in the United States, we compared cancer incidence in the Mormon and non-Mormon populations of Utah. In 1978 we published these comparisons for the

1966-1970 cancer incidence period (7), and in 1980 we published them for the 1967-1975 period (8).

Figure 1 shows the 1967-75 comparison of LDS to non-LDS incidence rates (SIRS), with 100 percent being the national rates from the Third National Cancer Survey. The non-LDS rates are fairly close to the national rates, while the LDS rates are lower at most sites. In particular, the smoking-associated sites show rates in the LDS about 40 percent below the national rates. The female sites of breast, cervix, and ovary have rates much lower than the national (and non-LDS) rates. Cancers of the colon-rectum, pancreas, stomach, and kidney are also low in the LDS for both sexes. No site shows significantly higher rates in the LDS than the non-LDS. Lip cancer has significantly higher rates in both the LDS and non-LDS than the national rates.

Urban vs Rural Cancer Comparisons

For the 1967-1975 incidence data we also compared the urban and rural cancer incidence rates in the Mormon and non-Mormon populations (9). "Urban" was defined as residence at the time of diagnosis in one of the four metropolitan counties of Utah (Salt Lake, Weber, Utah, Davis). "Rural" was defined as residence in one of the other 25 counties of the state. This definition is somewhat different from the census definition of "places of 2,500 or more," but it provides a relatively simple method of dividing the population into metropolitan and nonmetropolitan areas and is sufficient to describe the urban/rural differences in cancer incidence demonstrated in other studies.

Figure 2 shows the urban/rural comparisons in the non-LDS population of Utah. Higher urban than rural rates are demonstrated at many sites, as has been demonstrated in numerous other populations. The smoking-associated cancers particularly show wide differences, especially in males. Figure 3 shows the urban/rural comparisons in the LDS population. In this case most of the urban/rural differences disappear, particularly at the smoking-as-

sociated sites in men.

The non-LDS population of Utah demonstrates the urban/rural differences in cancer incidence so often seen in other studies, while the LDS population shows very few differences. The most commonly proposed explanation for urban/rural differences in cancer incidence relates to urban pollution. Our data do not support that hypothesis, since the gradient is seen only in the non-LDS population is minimal in the LDS, while both are exposed to urban pollution. A more consistent explanation relates to differences in life-style between urban and rural areas, and Mormons who live in urban areas demonstrate, with respect to cancer risk, a rural life-style. The urban/rural differences seen in the non-Mormon would then be attributed to these life-style differences, particularly with respect to smoking behavior, and to synergism between life-style and urban pollution.

Comparisons by Church Activity

Up to this point in our comparisons of cancer incidence in Mormons and non-Mormons, we have used merely existence of a membership record or a statement of membership in the LDS Church to define an individual as Mormon. Up to half of LDS members of record may be nonparticipating Mormons who may not adhere to the teachings and principles espoused by the Church. This particularly applies to the Church's "Word of Wisdom." In order to determine whether it is the health-related practices advocated by the Church or other factors (such as genetic factors) that explain the low cancer risk in the Mormon population, we tried to evaluate cancer incidence in Church members by measures of religious participation (Church activity). This information was obtainable only for deceased members, since we had to use detailed information from newspaper obituaries and Church membership records available to researchers only after a member has died. We therefore classified each deceased LDS cancer patient according to a measure of church participation. For men we

used priesthood office, and for women we used a subjective activity score assigned to each individual.

Comparison in LDS Men by Priesthood

We identified each male LDS cancer patient who was a Utah resident diagnosed with cancer from 1966-1970 and had died as of November 1975 (10). Each was classified according to priesthood office held at the time of diagnosis. This information was obtained from the historical membership record of the deceased individual. Three priesthood categories were defined: 1) no priesthood or Aaronic Priesthood only, 2) elder, and 3) seventy or high priest. These priesthood categories were used as estimates of the individual's degree of adherence to the health-related practices advocated by the Church. Because the higher priesthood offices are generally not given to individuals under age 20, we included all comparisons under that age, and all results are age-adjusted because of differences in age distribution by priesthood category.

Population denominators for these data were obtainable through use of the computer count of Church members in the central membership file performed in 1976. This enumeration provided counts of Utah male Church members by county, age, and priesthood office. This age and priesthood distribution was applied to the total Utah male Church membership reported for mid-1968. The number of deceased cases for each priesthood category in each age and county group were then divided by the respective mid-1968 population estimates. This produced age-adjusted cancer rates for deceased patients derived from the 1966-1970 incidence data. The ratios of these rates comparing one priesthood level to another then provide "follow-up rate ratios" which are equivalent to incidence rate ratios under the assumption that cancer survival does not vary with priesthood category.

Figure 4a shows the rates by age and priesthood category for all sites combined. The seventies and high priests have the lowest cancer in-

cidence—about half that of the none and Aaronic Priesthood only group, with the elders having intermediate rates. These differences are consistent in nearly all age categories. Figure 4b shows the results (using a larger scale) for the smoking-associated cancers. The seventies and high priests have rates less than 20 percent of those of the none and Aaronic Priesthood only group, while elders' rates are again in-between. Figure 4c shows cancer rates at the remaining sites, and they are about 20 percent lower in the seventy and high priest group—a much smaller difference, but still statistically significant.

Comparisons by site are shown in Figure 5. These are rate ratios comparing the three priesthood categories and the non-LDS, with 100 percent being the white incidence rates from the Third National Cancer Survey. Most of the smoking-associated cancers have incidence in the seventies and high priests less than 20 percent of the national rates. Low incidence is also seen in this group at sites of stomach and kidney. Cancers of the colon-rectum, pancreas, and prostate do not show consistent relationships with priesthood category.

Comparisons in LDS Women by Church Activity Score

The categorization of LDS women by Church participation measures was much more difficult than it was for men. There is no priesthood equivalent for women, and thus very little activity-related information appears on the Church membership record. We therefore relied quite heavily on the newspaper obituaries for activity information, and we classified each female LDS cancer patient—diagnosed during 1966-70 who had died as of November 1975—by a subjective activity score (11).

Church activity level was classified in four categories, with 1 denoting inactive and 4 very active. We obtained information on type of marriage (temple versus nontemple) from the historical membership record of the deceased individual. This was the most important factor in determining the ac-

tivity score. Additional information from the historical membership record (mission, temple worker, etc.) and from the newspaper obituary ("active Church member," Church offices held, type of funeral, etc.) was used to further refine the categorization. Activity level classification for each case was performed by one individual who was unaware of the site of cancer diagnosis.

Because of the lack of population information by activity score, we used a group of cancer sites to estimate this distribution in the LDS population. This control group comprised all cancer sites not associated with smoking or alcohol use or with significant differences between the LDS and non-LDS rates (i.e., all sites except lung, mouth and pharynx, esophagus, larynx, bladder, kidney, lip, breast, cervix, and ovary). The distribution of activity score for cases at each site was compared with that for the control group sites. This produced follow-up rate ratios which are equivalent to those calculated for males, with the same assumption of constant survival by activity category.

Comparisons by female activity score for selected sites are also shown in Figure 5. There was about a two-fold difference for the smoking-associated cancers in rates between the very active and inactive groups, but the differences are not nearly as striking as we saw in the male comparisons. Other sites show activity-related differences for cancers of the breast, pancreas, and colon-rectum—all sites showing definite differences between Mormons and non-Mormons. The paucity of large differences in these data for LDS females, in contrast to those seen in LDS males, may be explained by differences in effect of smoking and alcohol use on cancer risk in women, differences in the rate of use of these substances in inactive Mormon women, or imprecise classification of LDS women by Church activity level.

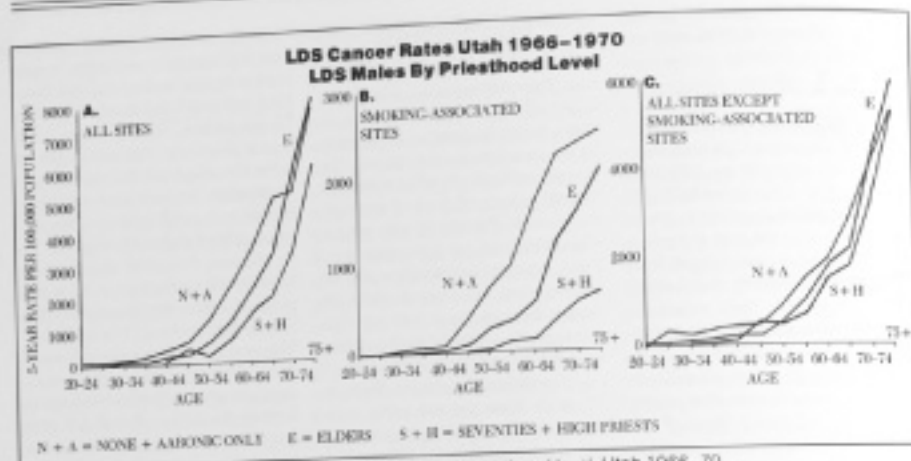


Figure 4: Mormon male cancer follow-up rates by age and priesthood level, Utah 1966-70.

Table 4. Characteristics of Utahns by religion and LDS Church activity, females (data from reference 12).

Factor	Non-LDS		LDS		
	Total	Total	Active	Partly Active	Inactive
Distribution (%)	22	78	56	21	24
Education					
<HS (%)	15	15	9	15	26
HS (%)	38	34	30	40	37
<COLL (%)	28	38	41	29	20
COLL+ (%)	21	16	19	16	5
Smoking					
Current (%)	41	7	1	4	33
Ever (%)	58	14	5	17	30
Alcohol Use					
Current (%)	60	17	1	22	48
Marital Status					
Single (%)	8	2	1	2	2
Married (%)	73	80	80	77	80
Divorced (%)	12	6	5	4	13
Widowed (%)	7	9	8	16	6
Avg. Age at First Marriage	21	20	20	21	19
> 1 Marriage (%)	25	20	15	21	31
Avg. Age at First Intercourse	20	20	21	19	18
> 1 Sex Partner (Lifetime) (%)	60	34	16	14	51
Avg. Number of Pregnancies	2.9	2.1	4.5	3.4	4.5
Avg. Age at First Pregnancy	21.6	21.9	23	23	21
Ever used BC Pills (%)	36	37	38	30	43
Ever had Hysterectomy	40		17		

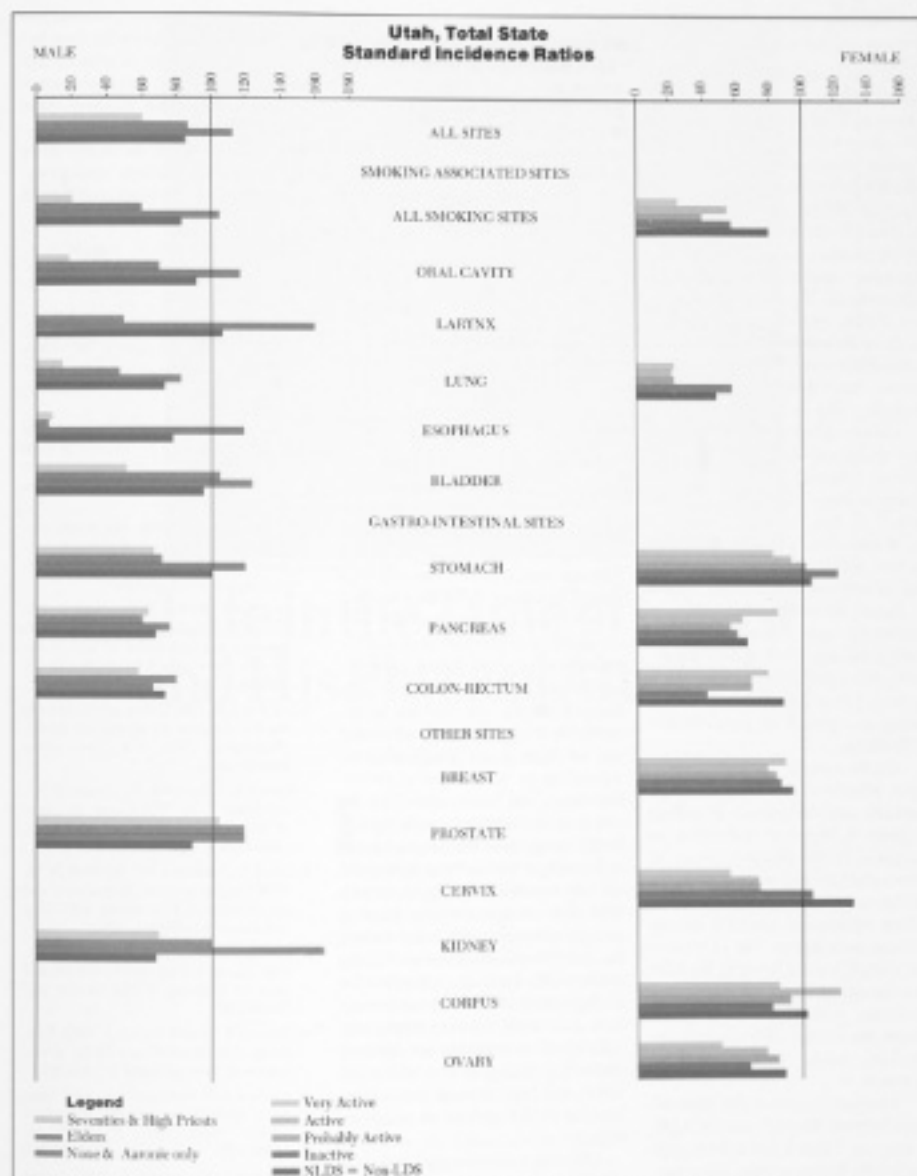


Figure 5: Standard incidence ratios for selected cancer sites by sex, religion, and Church activity level, Utah 1966-70. 100 percent = Third National Cancer Survey white rates.