THE ROLE of cigarette smoking as a risk factor in cerebrovascular disease (CBVD) remains unclear. Although several studies have implicated smoking as a factor predisposing to stroke, other investigations, including at least 2 large cohort studies, have shown no significant consistent correlation between smoking and deaths due to cerebrovascular accidents (CBVAs). The State of Utah offers an unusual opportunity to study the relationship between cigarette smoking and stroke, because of its large, non-smoking population, and Utah also has an age-adjusted mortality from deaths due to strokes 13% below that of the U.S.

Nearly 72% of the state's population are members of the Church of Jesus Christ of Latter-day Saints, commonly called Mormons or LDS. This church proscribes the use of cigarettes and other forms of tobacco, as well as coffee, tea, and alcohol. About 90% of church members in Utah are non-smokers, compared to about 65% of the U.S. population.

Mormon lung cancer rates are approximately 65% below those of the remainder of the U.S. In 1970, Utah had a lower per capita rate of alcohol and tobacco consumption than any other of the fifty states. Previous studies of disease among various religious groups have proved useful in clarifying the epidemiology of certain diseases. This has been done in Utah for LDS and non-LDS and has demonstrated a significant difference between LDS and non-LDS incidence rates for various types of cancer, especially those associated with cigarette smoking i.e. lung, larynx, oral cavity, and ischemic heart disease.

The purpose of this study was to determine if the state's lower-than-national mortality from stroke could be attributed to the large LDS portion of the state's population, with their lower-than-U.S-average use of tobacco.

Methods

From the Utah State Bureau of Vital Statistics, we obtained a list of all residents of Utah who died of stroke (ICD codes 430-438) during the years 1968-1971. The list was compiled from death certificates and it included name, age, sex, county of residence, date of death, and cause of death (ICDA code 430-438, Eighth Revision). We excluded deaths assigned to subarachnoid hemorrhage and cerebral embolism because of their lack of association with cigarette smoking. We then classified each case as to membership in the LDS church. This was possible because the LDS church headquarters in Salt Lake City has maintained a file of the church records of deceased church members since 1941. When a member dies, his local church unit (ward) sends his church membership record to the church headquarters where it is filed. The membership records are in alphabetical order and include name, sex, date of birth, date of death, and residence, as well as other information. Each ward covers a specific geographical area of the state and all members, regardless of adherence to church doctrines, belong to the ward in which they live. This data system is described in detail elsewhere.

Each of the cases was searched for membership in the LDS deceased membership file. Spelling variations for names, as well as alternating first and middle names, were also searched. All cases not matched as LDS by deceased membership file were then searched for religion in the obituaries of state and local newspapers. The figure gives a schematic diagram of the search process and the number of cases found by each method.

The state LDS — non-LDS populations were obtained from a church census and the method used here has also been described previously.

Cerebrovascular mortality for Utah and for the LDS and non-LDS sub-groups of the population were then compared to the U.S. white population for 1970, using standardized mortality ratios (SMRs). The U.S. white mortality rates were used since 97.4% of the state population is Caucasian.

The method of Bailar and Ederer, assuming a Poisson distribution, was used to test the difference between the state and each religious group and the U.S. population. A modification Mantel-Haenszel chi-square statistic, controlled for age by 5 year age
RESULTS

During the years 1968-1971, there were 2,647 deaths in Utah from cerebrovascular disease (ICD code number 430-438). Of these, 126 were assigned to subarachnoid hemorrhage and cerebral embolism (ICD 430,434) and excluded, leaving 2,521 deaths for analysis. For analytical purposes, we classified these into 8 categories (see table). Most of the strokes were classified as non-hypertensive (86.3%). The largest categories were the "ill-defined (436,437,438)," comprising 58% of the total deaths; "cerebral thrombosis and occlusion of precerebral arteries (432,433)," 26%; and "cerebral hemorrhage," 16%. Of the 2,521 stroke deaths, 1,861 (74%) were classified as LDS, and 699 (26%) were classified as non-LDS (see table).

In most cases, the differences between the LDS and non-LDS populations are not remarkable. LDS women have significantly more stroke deaths than non-LDS women. The major reason for this was the high mortality among LDS women of ill-defined strokes (436,437,438). LDS females have significantly higher mortality for this ill-defined category than both the non-LDS and the U.S. control.

In other categories, LDS men have significantly lower mortality than non-LDS men for occlusion of the precerebral arteries and cerebral thrombosis (432-433). For all strokes, non-LDS have a slightly lower mortality rate than LDS, but the difference is not statistically significant.

When we merge the 2 religious groups, there are, however, highly significant differences between the Utah population and the U.S. control population. In most cases, the Utah population mortality rate was lower than the U.S. expected. This was true for LDS males and non-LDS males and females for all strokes (ICD 431,433,434-438) and Utah men and women have lower mortality than the U.S. white population for cerebral hemorrhage (431); and occlusion of the precerebral arteries and cerebral thrombosis (432-433). For the ill-defined groups (436,437,438), the Utah men have a lower-than-expected rate; but this is offset by a higher rate in Utah women.

For a few causes of death, the Utah population has higher-than-expected mortality. For "acute and ill-defined conditions" (ICD 436,438) Utah women are 17% above the U.S. mortality rate. This excess is contributed exclusively by LDS women.

Overall, the State of Utah has a mortality rate from

<table>
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<th>ICD — 8th Revision</th>
<th>Sex</th>
<th>Cerebrovascular Deaths LDS</th>
<th>Standardized Mortality Ratio LDS</th>
<th>Cerebrovascular Deaths Non-LDS</th>
<th>Standardized Mortality Ratio Non-LDS</th>
<th>Standardized Mortality Ratio LDS compared to Non-LDS</th>
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*p < 0.05 SMR compared with U.S. White mortality rate.

†p < 0.01 compared with U.S. White mortality rate.
stroke 12.4% below the U.S. expected rate; males are 18.7%, and females are 6.8% below the U.S. rate.

Discussion

LDS men had lower mortality than non-LDS men and both were below the U.S. expectation, but only the latter association was statistically significant. LDS women had higher mortality than non-LDS women and were similar to the U.S. population. This pattern is not consistent with any biologic mechanism involving tobacco usage as a risk factor.

The LDS Church Historian's Office tries to have complete records, but some of the deceased members' records are not in the appropriate file. In some cases, local clerks are not aware of the death of a member and thus, the record is not sent to the church headquarters. We used newspaper obituaries to classify those cases whose names were not found in the deceased membership file, but since some obituaries do not mention religious preference, it is possible that some of the cases were misclassified. In a few cases, no obituary could be found. However, we feel the error introduced by this misclassification is small and in the direction of classifying non-LDS as LDS, and thus including a higher proportion of smokers in the LDS category.

It is also clear that this study classifies by religion, not by smoking history. However, other studies in Utah have found that about 40% of non-LDS are regular smokers while only 10% of the LDS population smoke.11

It is possible that some deaths may have been misclassified, but there is no reason to assume that this would apply more to one religious group than the other since no moral stigma is attached to a diagnosis of CBVD. Lower than U.S. rates have been explored including a higher proportion of smokers in the LDS population.12

We were unable to obtain a more accurate census for the LDS population 75 and older. This group is especially important, since stroke is primarily a disease of old age with 65 percent of our cases and 63% of all U.S. white strokes occurring at ages over 75. As a crude indicator of whether there might be a difference between the 2 religious groups in the age 75 plus category, we calculated the average age at death for the cases over 75. Only minor and insignificant differences between LDS and non-LDS were found.

Petitii and co-workers found smoking to be a risk factor for both subarachnoid hemorrhage and all strokes in young women in a large cohort study.18 We examined our data for the younger groups (aged 20–54) separately and found no significant difference between the LDS and non-LDS populations.

We find that there is no clear and unequivocal pattern of decreased mortality from stroke in one population in which smoking is less prevalent than another comparable one. It may be that cigarette smoking does not predispose one to die from a stroke as it does to death from heart disease. If so, then the pathogenesis of the arterial changes associated with stroke must be different from heart disease, and this needs further exploration.

In any event, there are significant differences between the Utah populations and the U.S. population which need to be explained. Close examination of epidemiologic factors, including diet and exercise, could also prove useful in explaining the low stroke mortality in Utah.

The previously cited studies of health differences in LDS11-12 all used the same record sources and methods of record matching and found a significant difference, while this study did not. This is the first study of a major mortality risk factor where Mormons did not enjoy a clear advantage over non-Mormons. As such, even though the data are negative, we believe that this is also an important finding, since it adds evidence to the presumption that the reported differences in the earlier studies are real and not an artifact of the study design or record resource.

References

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