Alcohol Abstainers: A Low-Risk Group for Cancer—A Cohort Study of Norwegian Teetotalers[1]

Kristina Kjærheim,[2] Aage Andersen, and Are Helseth

Cancer Registry of Norway, Institute of Epidemiological Cancer Research, Oslo, Norway

Abstract

Groups with assumed health-protective life-styles have been studied for several decades, in search of causes for cancer. We have analyzed cancer incidence, total mortality, and cause-specific mortality in Norwegian teetotalers to assess the possible health gains from an alcohol-abstaining life-style.

A cohort of 5332 members of the International Organization of Good Templars was followed for 10 years from 1980. The cancer incidence and the cause-specific mortality of the cohort has been compared to that of the total Norwegian population.

The standardized incidence ratio (SIR) for all cancer sites was 74 [95% confidence interval (CI), 64–80] for men and 72 (95% CI, 61–84) for women. For possible alcohol-associated cancers, such as cancer of the oral cavity, pharynx, esophagus, liver, and larynx, the SIR was 43 (95% CI, 17–88) for both sexes combined. For lung cancer the SIR was 57 (95% CI, 37–90) for men and 10 (95% CI, 0–57) for women. When all alcohol- and tobacco-associated cancers were excluded, the SIR for both sexes combined was 79 (95% CI, 69–87). The standardized mortality ratio for total mortality was 81 (95% CI, 65–74). This significant decrease in total mortality was caused by reduced risks for all major causes of death.

The study indicates that members of the Norwegian chapter of the International Organization of Good Templars are a low-risk group not only regarding alcohol- and tobacco-associated cancers, but also regarding all other cancers.

Introduction

The mechanism of alcohol carcinogenesis is not known, and despite repeated attempts, it has not been possible to increase significantly the incidence of tumors in experimental animals by the administration of alcohol (1). However, epidemiological studies of both cohort and case control type have shown an excess incidence of cancer of the mouth, pharynx, larynx, esophagus, and liver in groups with high alcohol consumption (2).

Cancer incidence and mortality in low-risk groups have been studied in two types of population. The first type consists of various religious groups with characteristic life styles that are assumed to be health protective. SDAs[3] have proscriptions against tobacco, alcohol, and meat. Mormons expect members to abstain from alcohol and tobacco. Studies of cancer incidence and mortality in SDAs have shown significant reduction of cancer of the mouth, pharynx, larynx, esophagus, lung, bladder, and cervix (3–5). A study of cancer in Mormons showed a low incidence of cancer in general, esophageal cancer and laryngeal cancer (6). A second study in Mormons found the cancer mortality at all smoking-related sites to be 58% and the mortality of all other cancers to be 68% of that in the general Californian population (7). Few studies on religious cohorts have been performed in Scandinavia. In a Danish study of SDAs in Copenhagen (8), the cancer incidence closely resembled that of the Calfornian SDAs.

The second type of low-risk groups is nonsmoking populations. For men, SMRs for cancer at all sites in such populations have been between 47 and 71, depending upon whether the comparison has been made with smokers or with the general population (9–11). For cancer of the lung, larynx, and pharynx, SMRs have been even lower. For women, the relative cancer reduction has been shown to be significant, but it is smaller than for men.

The incidence of cancers associated with alcohol in Norway is low compared with most other Western countries (12). The aim of this study was to investigate the impact of an alcohol-abstaining life style on cancer incidence in a population with already low background rates. We have therefore studied cancer incidence in Norwegian members of the IOGT, who have signed a written statement that they will not drink alcohol. Total mortality and cause-specific mortality were also investigated.

Materials and Methods

The cohort consisted of all members 10 years and older from the 200 larger and active IOGT lodges (local groups) on January 1, 1980. The remaining 153 lodges representing 20% of all the IOGT members were not included due to inactivity and/or small size of the group. The members were informed about the study through the magazine of the organization, and one person refused to participate.

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[2] To whom requests for reprints should be addressed, at Cancer Registry of Norway, Institute of Epidemiological Cancer Research, Montebello, 0310 Oslo, Norway.

[3] The abbreviations used are: SDAs, Seventh-Day Adventists; SMR, standardized mortality rate; SIR, standardized incidence ratio; IOGT, International Organization of Good Templars; CI, confidence interval.

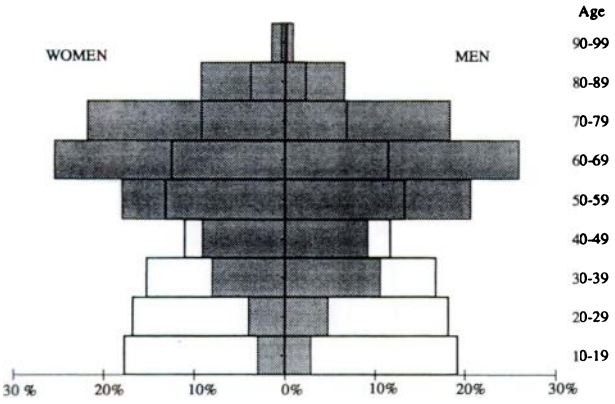

Fig. 1. The distribution of IOGT members by age and sex, January 1, 1980, compared with total population. □, IOGT; □, total population.

Furthermore, we were unable to identify 51 persons (1.0%) by the 11-digit personal identification code, leaving 5332 persons in the study group. Date of birth, sex, year of entrance into the organization, and year of quitting (if they left) the organization were registered. The distribution by sex and age is shown in Fig. 1. The age when they joined the IOGT was known for 4431 persons. Of these, 62.6% joined between 10 and 19 years of age, and 17.9% between 20 and 29.

Registration of cancer cases in Norway is based on compulsory reporting by hospital departments and histopathological laboratories. The coding of cancer cases is based on the seventh revision of the International Classification of Diseases, while causes of death up to 1986 were coded according to the eighth revision, and from then on according to the ninth revision. The unique personal identification number, which has been in use in Norway since 1960, was used to link cancer registrations, cause, and date of death to the IOGT file.

Cancer sites were classified according to known etiological factors. Cancer of the mouth, pharynx, larynx, esophagus, and liver were classified as alcohol associated (2). This is a simplification because alcohol-associated cancers, with the exception of liver cancer, are also causally related to tobacco exposure. Moreover, while alcohol and tobacco are the main causes of these cancer forms, they are not the only causes. Cancers of the lung, pancreas, and bladder were classified as tobacco-associated cancers (13).

The follow-up period was 10 years, from January 1, 1980, to December 31, 1989. The analysis was based on a comparison between the observed and the expected number of new cases of cancer and of deaths in the cohort. The 5-year age- and sex-specific incidence rates in the general population for each year from 1980 to 1989 were used to estimate the expected number of cases. The IOGT members were geographically evenly distributed over the country, and the expected incidence rates for the total population were used. SIRs were calculated for total cancer incidence and for the selected cancer sites. SMRs were calculated for total mortality, for seven main groups of causes of death, and for liver cirrhosis. Confidence intervals were determined by assuming a Poisson distribution of the observed number of cancer cases. A result was regarded as statistically significant if the 95% CI did not include 100. The χ^2 test was used for difference between the sexes and for trend and was done as described by Breslow and Day (14).

Results

During the 10 years of follow-up 350 new cases of cancer were observed *versus* 478 expected. This difference is statistically significant, the combined SIR being 73 (95% CI, 66–81) (Table 1). None of the SIRs for any single cancer site differ significantly between the sexes. The results are therefore in part presented with both sexes combined.

Table 1 Observed number of new cases of cancer and SIR in the Norwegian IOGT cohort, follow-up, 1980–1989

Cancer site	ICD-7[a]	Men		Women		Both sexes		
		Obs.[b]	SIR	Obs.	SIR	Obs.	SIR	95% CI
Lip	140	1	36	0	0	1	30	1–168
Tongue, mouth, pharynx	141–148	2	11	1	38	3	44	9–127
Esophagus	150	0	0	1	87	1	26	1–145
Stomach	151	11	61	9	71	20	65	40–101
Colon/rectum	153–154	33	90	32	81	65	85	66–108
Liver	155	1	54	0	0	1	31	1–173
Gall bladder	156	4	310	4	156	8	208	90–410
Pancreas	157	7	75	3	33	10	55	26–100
Larynx	161	2	70	0	0	2	62	8–225
Lung	162	18	57	1	10	19	46	28–72
Breast	170			37	80	37	80	56–110
Female genital	171–176			22	69	22	69	43–104
Prostate	177	56	95			56	95	71–123
Male genital	178–179	2	105			2	105	13–379
Kidney/bladder	180–181	21	72	9	68	30	70	47–100
Brain, meninges	193	3	70	6	127	9	100	46–190
Hematopoietic	200–207	17	102	12	82	29	93	62–133
Other specified sites		10	47	17	80	27	63	42–92
Other unspecified sites	199	1	9	7	60	8	37	16–73
All cancers	140–209	189	74	161	72	350	73	66–81

[a] Seventh revision of the International Classification of Diseases.
[b] Observed number.

Table 2 Observed and expected number of total cases of cancer and of lung cancer 1980–1989 in the Norwegian IOGT cohort (both sexes combined)

Birth cohort	Person-years	Total cancer				Lung cancer			
		Obs.[a]	Exp.	SIR[b]	95% CI	Obs.	Exp.	SIR[c]	95% CI
1880–1909	10,210.0	161	197.4	82	69–95	9	11.5	78	36–149
1910–1919	12,531.5	118	169.1	70	59–85	9	17.6	51	23–97
1920–1929	10,560.5	50	82.7	60	45–80	1	10.2	10	0–55
1930–1969	14,090.5	21	28.8	73	45–112	0	2.1	0	0–179
Total	47,392.5	350	478.0	73	66–81	19	41.4	46	28–72

[a] Obs., observed number; Exp., expected number.
[b] χ^2 test for trend, $P < 0.0001$.
[c] χ^2 test for trend, $P < 0.0025$.

Cancers in sites associated with alcohol consumption were rare. Altogether there were 7 observed cases *versus* 16.43 expected and a SIR of 43 (95% CI, 17–88). The SIR for lung cancer was also significantly reduced, being 46 for both sexes combined based on 19 observed cases *versus* 41.4 expected. Analyzing lung cancer in men and women separately gives a SIR of 57 for men and 10 for women. When all alcohol- and tobacco-associated cancers are excluded, cancer incidence was still significantly reduced, with a SIR of 79 (95% CI, 69–87).

The SIR for pancreatic cancer is 55 (95% CI, 26–100). The SIR for breast cancer in women is reduced, but not significantly so. For women 69 years old and younger, the SIR is 65 (95% CI, 39–103), and for women 70 and older, the SIR is 102 (95% CI, 61–159). For the group "other unspecified sites" the SIR is 37 (95% CI, 16–73). In men, only one case was observed *versus* 10 expected. There is no significant increase in any cancer form. Only cancer of the gall bladder and male genital cancers show a SIR of more than 100.

If the study group is divided into four birth cohorts, a pattern of gradually decreasing SIR for total cancer appears for the three oldest cohorts (Table 2). While the oldest cohort, born between 1880 and 1909, has a SIR of 82, the two following cohorts have SIRs of 70 and 60, respectively. The youngest cohort, born between 1930 and 1969, breaks this pattern but includes fewer cancer cases. The χ^2 test for trend across the strata is significant ($P < 0.0001$). Lung cancer risk in these four birth cohorts has the same pattern as the total cancer incidence (Table 2). The cohort born between 1920 and 1929 shows one observed lung cancer case *versus* 10 expected. The test for trend across the strata is significant ($P < 0.0025$), showing that the reduction of risk is greatest in the younger age group.

The SMRs for total mortality are 79 for men and 83 for women, and both are statistically significant (Table 3). The observed number of cases never exceeds the expected number in any disease group. The mortality from digestive and respiratory diseases is also low, SMR for the former being 64 and for the latter 68. The very low SMR for disease in the digestive system in women is due partly to reduced gastric ulcer mortality, partly to a general reduction of these diseases. Liver cirrhosis, which is also included in this group, has a SMR based on four cases in both sexes of 64 (95% CI, 18–167). The low SMRs for "other causes" in both sexes are mainly explained by reduced mortality from sudden death, infections, and alcoholism. A separate analysis of the mortality from circulatory disease by birth cohort shows a gradual reduction of SMR from the oldest cohort through the two younger cohorts (not shown). The χ^2 test for trend is statistically significant ($P < 0.0025$).

Discussion

The present study represents the first cohort of organized alcohol abstainers. It shows a lower incidence of total cancer, lung cancer, and alcohol-associated cancers in both male and female members of IOGT. When cancers with an established association with alcohol drinking and/or tobacco smoking are excluded, cancer incidence is still significantly below that of the Norwegian population. In addition, total mortality is also significantly reduced in both sexes. The mortality from diseases of the respiratory and digestive systems is especially low.

The low cancer incidence and total mortality are similar to those found in SDAs and Mormons (3–8). The results also correspond to rates found in nonsmoking populations (9–11). A similar reduction, however, was

Table 3 Observed number of deaths and SMR in the Norwegian IOGT cohort by cause of death, follow-up, 1980–1989

Cause of death	ICD[a] code	Men		Women		Both sexes		
		Obs.	SMR	Obs.	SMR	Obs.	SMR	95% CI
Malignant neoplasms	140–208	136	83	117	85	253	83	73–93
Benign neoplasms	210–239	1	35	4	100	5	73	24–170
Circulatory disease	390–459	312	82	332	89	644	85	78–92
Respiratory disease	460–519	46	65	54	71	100	68	56–83
Digestive system	520–579	18	90	10	44	28	64	43–94
Accidents, etc.	E800–E999	24	79	27	91	51	85	63–112
Other causes		48	65	55	71	103	68	59–81
All causes		585	79	599	83	1184	81	65–74

[a] ICD, International Classification of Diseases; Obs., observed number.

not found in a study of cancer incidence in Norwegian SDAs (15). The authors suggest that the generally low cancer incidence in Norway explains this lack of effect on the SIR in Norwegian SDAs, indicating that life-style factors in this case contribute less to cancer incidence. The present study, however, shows that life-style factors such as alcohol drinking and tobacco smoking contribute substantially to cancer rates and total mortality. One reason for the lack of effect in the Norwegian SDA study may be, as the authors themselves suggest, that the inclusion of all registered Adventists, regardless of religious activity or adherence, is too wide a criterion. In the case of the IOGT cohort, passive and/or small lodges with little or no contact with the central organization were excluded from the study, with the object of studying active teetotalers exclusively.

The consumption of alcohol in Norway has been low compared with that of most other Western countries, and smoking became widespread only after 1945. This leads us to expect weaker contrasts between abstainers from alcohol and tobacco and the general population. In 1950, the mean annual consumption of alcohol in Norway was less than one-half the consumption in the United States and Britain and about 10% of the consumption in France (16). In 1956, 32% of the population did not drink any alcohol. This proportion decreased to 23% in 1985 (17). The increase in alcohol consumption has occurred predominantly in the younger age groups. In 1985, 36% of men and 59% of women 67 years and over did not drink any alcohol. These figures are important in explaining the low incidence of alcohol-associated cancers in Norway (18). In addition, in 1964 a questionnaire sent to a sample of the population born between 1895 and 1929 revealed that 55% of the men and 19% of the women were current smokers. Twenty-two % of the men and 76% of the women had never smoked (19). Thus, the reference populations of both sexes in the relevant age groups have had a low consumption of alcohol compared with other Western countries. Women, especially, have been much less prone to smoking.

We have no information on individual exposure to alcohol and tobacco in the IOGT cohort. Members of the IOGT must, however, give an oath never to drink alcohol. Social control in the organization is strong, so there is every reason to believe that this oath is kept by the great majority of the members. Reformed alcoholics have mostly been drawn to other organizations. A Swedish study showed that less than 1% of IOGT members were former alcoholics (20). It is reasonable to assume that an equal or even smaller fraction of the Norwegian members were former alcoholics. Exposure to tobacco is harder to judge because there is no formal ban against tobacco smoking. Culturally, however, the organization is linked to a nondrinking, Protestant religious tradition, in which nonsmoking is an important factor. Furthermore, a correlation between smoking and drinking, and nonsmoking and nondrinking, has been shown in several studies (2).

Women in the IOGT have a SIR of 10 for lung cancer (95% CI, 0–44), based on one case only. This corresponds to an incidence rate which is equivalent to the lung cancer rate in Norway at the beginning of the century (21). The age-adjusted incidence rate for the general female population in the period from 1982 to 1986 is 12.8/100,000 (22). The low lung cancer incidence rate for IOGT women could be interpreted as a result of several factors acting together: nonsmoking, no or little passive smoking, and probably few occupational or other exposures to lung carcinogens.

The incidence of breast cancer in women is low in the IOGT cohort, but not significantly so. Women 69 years old and younger have a smaller SIR for breast cancer than the older women. Several previous studies have shown a relationship between increasing alcohol consumption and risk for breast cancer in women (23–25), while other studies have failed to confirm this association (26, 27). In the general population an increase of alcohol consumption has taken place, and this may explain the lower risk for younger IOGT women. Thus, our data are in accordance with the hypothesis of an association between alcohol consumption and breast cancer.

For total cancer incidence, lung cancer incidence, and circulatory disease mortality, the study shows a gradual and statistically significant decrease from the oldest cohort to the youngest. This corresponds to the increasing prevalence of smoking in the general Norwegian population. The youngest cohort, born between 1930 and 1969, shows no significant difference from the general population. This may be due to the fact that the incidence rates in the general population are still low in these age groups. Another possibility is that IOGT members in these age groups have a higher proportion of smokers.

One should consider the possibility of diagnostic bias. Is it possible that IOGT members have a smaller chance of a diagnosis which is associated with alcohol consumption than others? This might be true for liver cirrhosis, because of the possible stigmatizing effect of that diagnosis, but it is probably not so for cancer. Ninety-two % of the cancer diagnoses in this study were histologically verified. Also, if there was a diagnostic bias, one would expect excess cancers of other types, e.g., unspecified cancer diagnoses. The SIR for unspecified cancers in both sexes was 37 (95% CI, 66–81), indicating that the IOGT members had a greater chance of a specific cancer diagnosis than the general population. This would tend to underestimate the contrasts between the studied population and the reference population. Imprecise diagnoses due to old age do not represent a bias because the reference population is of the same age.

The finding of low cancer rates in general, which are still significantly reduced when alcohol- and tobacco-associated cancers are excluded, is interesting. It might indicate that tobacco and/or alcohol is associated with more cancer types than are known so far. It might also be that other positive health habits are present in a low-smoking, nondrinking population. IOGT has no proscriptions, however, for diet, exercise, or other activities traditionally linked to good health. Furthermore, the organization has never been concerned with the health of the individual, it is the "health" of society as a whole which has been of importance. The organization is, however, known to be family and work oriented, with an upward social mobility (28). These factors may be social indicators of a health-protective life style in general. Studies of cancer incidence in relation to social support and network may give some support to this theory (29, 30). In favor of this theory is the low cancer rates in SDAs and Mormons, which are also found at cancer sites not

related to alcohol or tobacco. Nonsmokers as a group do not seem to show this overall reduction of cancer incidence or cancer mortality (10).

This study indicates that lower cancer rates and total mortality may be expected in nondrinking, low-smoking populations. This may be substantial in a relatively low-consumption country such as Norway. The study also raises the question of whether alcohol and/or tobacco may be linked to cancer types other than those documented so far, and whether the social support found in a closely knit organization may be a factor in cancer protection. The results from this study of Norwegian teetotalers support the WHO recommendation (31) to reduce alcohol consumption in the struggle for global health.

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