

COHORT PROFILE

The Danish religious societies health study

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How did the study come about?

Most members of religious communities are convinced that their religious beliefs and practices influence their risk for chronic diseases;^{1–3} physicians and professionals working within religious communities may have a similar view. Both the lay public and the medical community have become more interested in the association between religious practices and the risk and prognosis of chronic diseases, and there has been an ‘explosion’ of peer-reviewed scientific publications on the associations between religion, spirituality and health.⁴ We recently reviewed studies of the association between religious practices and risk for cancer and found a statistically significant protective effect of membership in a religious community.⁵ We observed that the risk reduction was probably associated with compliance with a lifestyle that was part of the recommendations of the religion. The hypothesized decrease in risk for cancer among members of religious communities has been extended to hypothetical reductions in the risks for cardiovascular diseases, psychiatric diseases and a number of chronic respiratory diseases.^{6–14} Several studies support the idea that religious beliefs and practices increase longevity.^{15,16}

Studies among Adventists in California (mortality among Seventh-day Adventists in 1960–66^{17,18} and the first Adventist Health Study in 1974–88^{19–21}) indicated that Adventists had lower risks for most cancers, cardiovascular disease and diabetes, and women lived 4.4 years and men 7.3 years longer than the general California population.^{14,22} Adventists abstain from smoking and use of alcohol and follow a theologically based diet. Similar findings of decreased risks emerged from studies of Mormons.^{23,24} So far,

only two studies of religious groups in Denmark have been published^{25,26} and a few studies have been reported in other European countries.²⁷ These generally support the finding of reduced risks for lifestyle-associated chronic diseases.

The methods used in the studies published so far have been widely discussed, and, in particular, the methods for selecting participants have been criticized, as inclusion of survivors only introduces a ‘healthy survivor effect’.²⁸ Furthermore, although the associations may be explained by lifestyle and behaviour, most studies in this field of research have been carried out in the USA; therefore, certain cultural aspects of religion when integrated into other societies and everyday behaviour may not be covered. In addition, few studies have been carried out in generally secular countries, further limiting the reliability of the outcomes.^{6–14,29–43} Finally, no cross-cultural investigations have been published of an association between religion in general and risk or prognosis of disease.

To address some of the above-mentioned limitations, we organized the Danish Religious Societies Health Study, which started in 2003. First, we established a nationwide cohort of members of various religious communities characterized by different types of lifestyle and behavioural recommendations. The Danish State has accepted secular traditions, being the first to legalize pornography in 1969, to provide free access to abortion before the 12th week of gestation in 1973 and gay and lesbian marriages in 1989, and Denmark has been characterized by sociologists of religion as one of the ‘least religious nations in the world’.^{44,45}

The study cohort reported here comprises members of Seventh-day Adventist and Baptist societies in Denmark, which have membership records far back

in time. We took advantage of access to a number of nationwide population-based registers and used the unique personal identification numbers to link individual data from member files with register information on morbidity and mortality and on several socio-economic indicators, such as educational level, income and marital status.

What does the study cover?

The aim of the Danish Religious Societies Health Study is to investigate the influence of religious practices on the risks for various chronic diseases, such as cancer, cardiovascular disease and psychiatric diseases. In addition, we are interested in the prognosis and survival of members of these communities who acquire one of these diseases. Finally, we will use information on this cohort as a reflection of preventive lifestyle interventions in modern industrialized and affluent countries.

Who is in the sample?

The sample comprises members of the Seventh-day Adventist church and the Danish Baptist church who were born in Denmark. We included both present and former members of the Adventist church registered at the headquarters of the Danish Adventists in Copenhagen, where the officials stated that all members during the period 1920–2005 were listed. We registered the name, name at birth, date and place of birth and date of death for each member. We typed and re-typed information from 16661 index cards with at least information on name and date of birth and added 3396 records that were available electronically, for a total of 20057 index cards (Figure 1). We excluded 1997 members not born in Denmark, 690 for whom the birth date was missing or invalid and 58 obvious duplicates.

The main office of the Baptist church advised us that information on its members could be obtained by contacting each of the 46 Baptist communities in Denmark. From the 26 communities that agreed to participate in the study, we obtained information on members by one of two methods. For 14 communities, we contacted individual members listed in the Baptist community offices directly to obtain name, date of birth and other information. We received information from 569 members (36% of all 1563 members). Secondly, we visited 12 Baptist communities, where we typed and re-typed information directly from membership lists, thus ensuring 100% participation from these communities. We thus obtained the names and dates of birth of 5473 Baptist church members. We consider that the sample of Baptist communities is random and that it is unrelated to any of the planned study outcomes. In total, our Baptist cohort comprises 6042 people (Figure 1).

To further identify the Adventist and Baptist church members, we used the Danish civil registration system,⁴⁶ which was established in 1968 to register all people alive and living in Denmark. The system includes a 10-digit unique personal identification number (the CPR number), sex, date of birth, place of birth and place of residence and is continuously updated with information on vital status (alive, dead, emigrated or disappeared) and the identity of parents, spouses and children.⁴⁶ To follow the members of the religious societies in the civil registration system and other registers, we identified the CPR number of each person by submitting the birth dates of all members in our file, excluding those with a date of death before 1968 (1793 Adventists) and those who already had a CPR number (1545 Adventists).

By computerized linkage and thorough visual inspection by two independent people, we compared our file with a data set of all Danish residents born on the same dates and identified people born on the same day, with

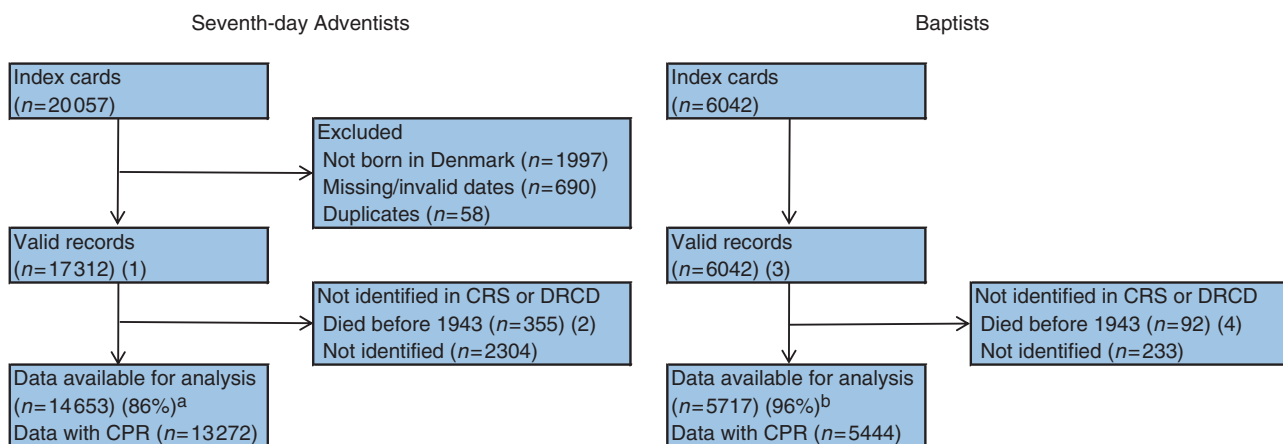


Figure 1 Flow diagram of identification of Seventh-day Adventist and Baptist member cards. ^aPercentage is number divided by (1) minus (2) ($n = 16\,957$) and ^bpercentage is number divided by (3) minus (4) ($n = 5950$). CRS, civil registration system; DRCD, register of causes of death; CPR, CPR number

Table 1 Descriptive statistics of Danish Seventh-day Adventists and Baptists

	Seventh-day Adventists	Baptists
Index cards, <i>n</i>	14 653	5717
Individuals, <i>n</i>	7905	3980
People with CPR, <i>n</i>	6532	3720
Women, <i>n</i> (%)	5038 (63.7)	2331 (58.6)
Deaths, <i>n</i> (%)	4918 (62.2)	1577 (39.6)
Person-years of follow-up, mean (SD) ^a	33.3 (17.5)	39.4 (17.5)
Person-years of follow-up, sum	262 893	157 000
Duration of membership, mean (SD) (years)	33.8 (20.7)	44.9 (19.4)
Age at membership, mean (SD) (years)	31.4 (18.5)	20.9 (10.9)
Age at membership (years), median	23.8	17.3
Resigned, <i>n</i> (%)	1259 (15.9)	–
Parents were members, <i>n</i> (%)	1717 (21.7)	1527 (38.4)
Members of national church of Denmark, <i>n</i> (%) ^b	2273 (34.8)	647 (17.4)
Married or widowed, <i>n</i> (%) ^c	2161 (72.4)	1857 (77.3)

^aFollow-up from date of birth, start of membership or 1943, whichever came last, until death, emigration or end-of follow-up (18 February 2010), whichever came first.

^bStatus at end of follow-up based only on people with CPR number.

^cStatus at end of follow-up based on people with CPR number who were alive at the end of follow-up. CPR, CPR number, personal identification number; SD, standard deviation.

the same date of death, if available, and with consistent names (both present and at birth), place of birth and membership of the national church in Denmark in both the member file and the civil registration system file. In this way, we identified the CPR number of 13 272 Adventists and 5444 Baptists (Figure 1).

For 3685 Adventists and 508 Baptists with no identification in the civil registration system or who died after 1943 and before 1968, we matched our files with the Danish Register of Causes of Death, which contains computerized information on date and cause of death from 1943 to 2008.⁴⁷ By matching date of birth, date of death, if available, and present and birth names, we identified a further 1381 Adventist members (37%) and 273 Baptist members (54%).

The final database, therefore, consists of 20 370 index cards identified either by CPR number (13 272 Adventists and 5444 Baptists) or by cause of death (1381 Adventists and 273 Baptists). These represented 86% of the Adventist index cards and 96% of the Baptist index cards.

In order to ensure that the same person was not registered on several index cards, e.g. when moving from one church to another, we checked for duplicates. In this way, we reduced the cohort to 7905 Adventists and 3890 Baptists, including 11 people registered as both an Adventist and a Baptist.

What has been measured?

From the index cards, we obtained the name, including birth name, date of birth, date of christening, date

of enrolment and, if available, resignation from the religious society, date of death and whether the parents were also members of the society. The mean duration of membership was 34 years for Seventh-day Adventists and 45 years for Baptists. The parents of 22% of the Seventh-day Adventists and 38% of the Baptists were also members (Table 1).

Information from the civil registration system shows that the proportion of members of the Evangelical Lutheran Church of Denmark (Church of Denmark) is markedly lower in this cohort (35% and 17%) than in the general Danish population (80% in 2011⁴⁸), whereas the proportion of married or widowed people is larger (72% and 77%, with 43% in the general Danish population) (Table 1).

The cohort is also different in terms of religious identity, vigour and practice from the Danish population. Seventy-two per cent of the Danes call themselves 'believers', 80% are as mentioned members of the Church of Denmark, but only 3% attend church once a week and 9% of Danes consider religion very important to them.⁴⁹ Sociologist Grace Davie's dictum for religious identity in Britain 'believing without belonging'⁵⁰ does not seem to apply to Denmark where 'believing and belonging without practising' would be more appropriate. Minority churches are generally known to have higher rates of practice and religious vigour than churches with a large local following.⁵¹

The majority of the cohort is women, and approximately half had died by February 18, 2010, most deaths occurring among members of the Seventh-day Adventists (Table 1). The mean length of follow-up is 33 and 39 years, respectively, and the

total number of person-years at risk is 419 893, making it possible to follow the cohort even for rare diseases. The Baptists were younger than the Seventh-day Adventists when they became members, which may be because a larger proportion had parents who were also members.

How often will the study subjects be followed-up?

Morbidity and mortality can be measured among participants in the Danish Religious Societies Health Study because of the complete, nationwide registration of all citizens in Denmark. This extensive registration makes it possible to conduct epidemiological studies of complex problems with no contact with the individual. In addition, nationwide registration is mainly for administrative purposes, e.g. taxation, which is not related to the hypothesis of the research. Furthermore, administrative data are obtained from all residents, leaving no room for selection bias; as in most cases, the registers are based on electronic reporting, recall bias is also minimized. Finally, the nationwide, population-based data ensure complete follow-up of all members of the cohort, a clear advantage over previous studies of religious cohorts.

All people with a CPR number will be linked to several nationwide registers with information available annually. Annual information since 1980 on job category, gross income, marital status and family type at the individual level is available from the Integrated Databank for Labour Market Research.⁵² Information on applications for income compensation, including unemployment compensation, health benefits, cash benefits and various types of pension, is available from 1984 in Coherent Social Statistics.⁵³ All such compensation is provided by the Danish State. Information on residence ownership and occupational area is available from 1981 in the Building and Housing Register.⁵⁴

All cohort members can be linked with the Danish Cancer Registry, which was established in 1943.⁵⁵ Studies of survival and of psychiatric hospitalizations after cancer diagnosis will also be possible.^{56,57} Analysis of causes of death is described below.

By linkage with the Danish National Patient Register,⁵⁸ hospital admissions for specific diagnoses, e.g. cardiovascular or neurological diseases, can be analysed. It will also be possible to study associations between diseases by register linkage⁵⁹ or to study social inequality in cancer incidence in this cohort characterized by low exposure to detrimental lifestyle risk factors through adherence to religious recommendations.⁶⁰

Analyses of psychiatric disease incidence, e.g. of severe depression, will be possible, by linkage with the Danish Psychiatric Central Research Register, established in 1969.⁶¹ We might also explore linkage to

the Danish National Prescription Registry, which contains information on prescriptions for drugs dispensed at all pharmacies in Denmark from 1995 onwards. The available information includes the type of drug prescribed according to the Anatomical Therapeutic Chemical classification system and date of issue from the pharmacy.⁶² In Denmark, for example, antidepressants are available only on prescription, and we may be able to obtain information on all prescriptions for antidepressants in the relevant group.

What is the rate of loss likely to be?

As we do not depend on contact with the members of the cohort and because of the nationwide registration of disease outcomes, loss to follow-up will be minimal and non-differential.

What has been found?

We have already studied the mortality rate of the cohort and compared it with that of the Danish population by following up the cohort in the Danish Register of Causes of Death from 1943 to 2007.⁴⁷ We calculated the numbers of deaths due to diseases related to lifestyle (liver cirrhosis, chronic obstructive lung disease, cardiovascular disease, diabetes and malignant diseases), behaviour (alcoholism, traffic accidents and suicide) and to causes other than lifestyle or behaviour (multiple sclerosis and Parkinson's disease).

We estimated the standardized mortality ratio (SMR), defined as the ratio between the observed and the expected numbers of deaths due to a specific cause, for the period 1943–2007. The sex-specific expected number of deaths was calculated by multiplying the number of observed person-years divided into age- and calendar year-specific (1-year groups) strata by the corresponding mortality rates. These mortality rates, derived from the relevant stratum in the entire Danish population, were calculated by dividing the number of deaths by person-years at risk. The 95% confidence interval (95% CI) of the SMR was derived on the assumption that the observed numbers followed a Poisson distribution.

The all-cause mortality rates for both men and women were significantly lower in the cohort than in the Danish population, with SMRs of 76 (95% CI 73–79) for men and 87 (84–89) for women (Table 2). Similar numbers were observed for Seventh-day Adventists and Baptists separately. The mortality rates from liver cirrhosis, chronic obstructive lung disease and lung cancer were much lower than in the Danish population; for example, the SMR for lung cancer was 28 (19–39) for male and 42 (29–59) for female Seventh-day Adventists. Significantly lower SMRs were also observed for heart disease. The

Table 2 Standardized mortality ratios for Danish Seventh-day Adventists and Baptists, Denmark, 1943–2007

Sex	Cause of death	Seventh-day Adventists			Baptists			Total		
		Obs	Exp	SMR (95% CI)	Obs	Exp	SMR (95% CI)	Obs	Exp	SMR (95% CI)
Male	All causes	1590	2015.5	79 (75–83)	625	894.4	70 (65–76)	2215	2909.9	76 (73–79)
	Lifestyle-related deaths									
	Liver cirrhosis	7	20.5	34 (14–71)	3	12.3	24 (5–71)	10	32.8	31 (15–56)
	COLD	23	79.1	29 (18–44)	15	39.1	38 (22–63)	38	118.2	32 (23–44)
	Diabetes	18	28.7	63 (37–99)	12	14.4	84 (43–146)	30	43.1	70 (47–99)
	Heart disease	597	808.7	74 (68–80)	236	326.8	72 (63–82)	833	1135.5	73 (69–79)
	Ischaemic heart disease ^a	421	557.1	76 (69–83)	171	232.9	73 (63–85)	592	790.1	75 (69–81)
	Cancer	304	494.8	61 (55–69)	152	234.9	65 (55–76)	456	729.7	63 (57–69)
	Lung cancer	33	119.5	28 (19–39)	28	62.8	45 (30–65)	61	182.3	34 (26–43)
	Breast cancer	0	0.7	0 (–)	0	0.3	0 (–)	0	1.0	0 (–)
	Colon cancer	41	43.3	95 (68–129)	20	19.6	102 (62–157)	61	62.9	97 (74–125)
	Rectum cancer	14	31.5	44 (24–75)	9	13.3	68 (31–129)	23	44.8	51 (33–77)
	Behaviour-related deaths									
	Alcoholism	4	7.2	56 (15–143)	2	5.1	40 (5–143)	6	12.2	49 (18–107)
	Traffic accidents	0	25.1	0 (–)	1	13.7	7 (0–41)	1	38.9	3 (0–14)
	Suicide	4	40.7	10 (3–25)	1	23.5	4 (0–24)	5	64.2	8 (3–18)
	Deaths unrelated to lifestyle or behaviour									
	Multiple sclerosis ^a	3	2.4	123 (25–358)	2	1.5	137 (17–494)	5	3.9	128 (42–299)
	Parkinson's disease ^a	9	6.7	133 (61–253)	6	3.1	196 (72–427)	15	9.8	153 (86–252)
Female	All causes	3173	3533.6	90 (87–93)	860	1116.7	77 (72–82)	4033	4650.2	87 (84–89)
	Lifestyle-related deaths									
	Liver cirrhosis	17	26.4	64 (38–103)	8	10.2	78 (34–154)	25	36.6	68 (44–101)
	COLD	44	82.1	54 (39–72)	11	36.3	30 (15–54)	55	118.4	47 (35–61)
	Diabetes	59	59.0	100 (76–129)	9	19.8	46 (21–87)	68	78.8	86 (67–109)
	Heart disease	1099	1395.9	79 (74–84)	301	376.5	80 (71–90)	1400	1772.4	79 (75–83)
	Ischaemic heart disease ^a	669	857.7	78 (72–84)	196	236.4	83 (72–95)	865	1094.1	79 (74–85)
	Cancer	622	808.4	77 (71–83)	197	298.2	66 (57–76)	819	1106.6	74 (69–79)
	Lung cancer	33	79.3	42 (29–59)	19	38.9	49 (29–76)	52	118.2	44 (33–58)
	Breast cancer	100	135.7	74 (60–90)	35	53.4	66 (46–91)	135	189.1	71 (60–85)
	Colon cancer	58	92.6	63 (48–81)	24	30.6	79 (50–117)	82	123.2	67 (53–83)
	Rectum cancer	34	41.4	82 (57–115)	8	13.5	60 (26–117)	42	54.9	77 (55–104)
	Behaviour-related deaths									
	Alcoholism	0	2.8	0 (–)	0	1.9	0 (–)	0	4.8	0 (–)
	Traffic accidents	2	17.8	11 (1–41)	0	7.4	0 (–)	2	25.2	8 (1–29)
	Suicide	3	37.7	8 (2–23)	3	18.2	17 (3–48)	6	55.9	11 (4–23)
	Deaths unrelated to lifestyle or behavior									
	Multiple sclerosis ^a	1	4.9	20 (1–113)	2	2.6	78 (10–283)	3	7.5	40 (8–117)
	Parkinson's disease ^a	12	10.1	119 (62–208)	5	3.4	147 (48–344)	17	13.5	125 (73–202)

^aFollow-up for 1951–2007 because ischaemic heart disease, multiple sclerosis and Parkinson's disease did not have separate classification codes in the Danish Register of Causes of Death between 1943 and 1950.

Obs, observed number of cases; Exp, expected number of cases; SMR, standardized mortality rate; 95% CI, 95% confidence interval; COLD, chronic obstructive lung disease.

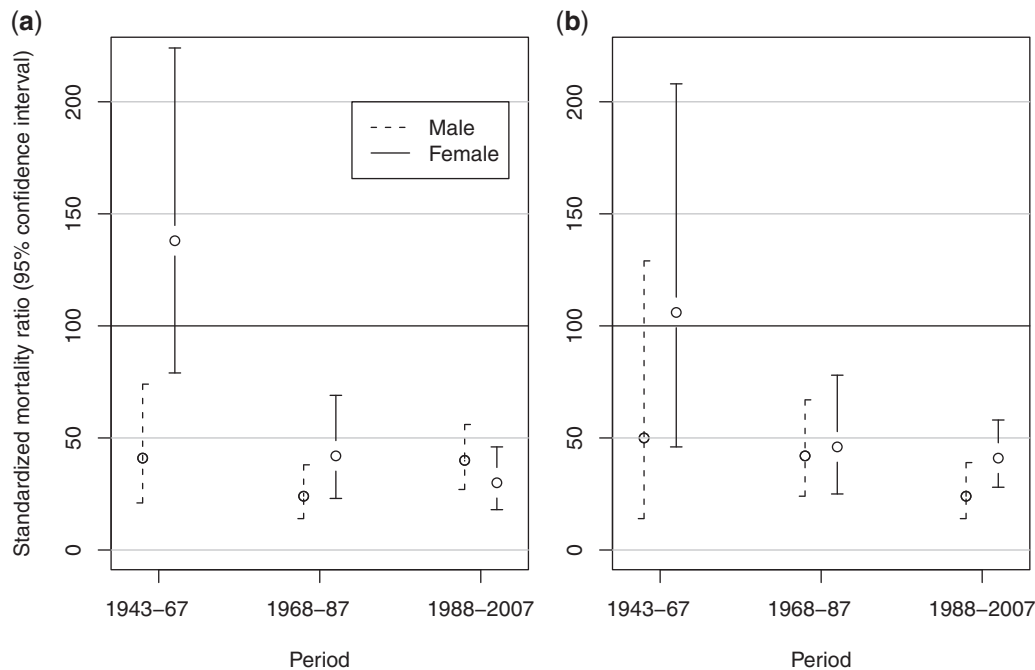


Figure 2 SMRs of Seventh-day Adventists and Baptists during three periods for (a) lung cancer and (b) chronic obstructive lung disease, Denmark, 1943–2007

SMRs for lifestyle-related deaths among men were almost consistently lower than those among women, which may reflect higher exposure of the general male population to detrimental lifestyle factors, e.g. smoking and alcohol drinking, than women, especially in the past. Juel, for instance, showed that the mortality rate from lung cancer among women has increased markedly since the 1960s.⁶³ To further explore this issue, we stratified the follow-up for lung cancer and chronic obstructive lung disease into three periods (1943–67, 1968–87 and 1988–2007) and found that men had lower SMRs for all three periods, whereas women had decreased SMRs only for the two last periods (Figure 2). Thus, the mortality rate was decreased in all periods during which time the general Danish population had high smoking rates.

The SMRs for deaths due to behavioural causes were low, e.g. the SMR for suicide was 8 (3–18) among men and 11 (4–23) among women. Similar results were found for traffic accidents. The rates for multiple sclerosis and Parkinson's disease were not significantly different from those of the general Danish population.

These results indicate that the mortality rates, and especially those related to smoking, were markedly lower among members of this cohort than in the Danish population. The results are in line with those of studies in the USA that showed that Adventists^{17–21} and Mormons^{23,24} had lower mortality rates for most cancers, cardiovascular disease and diabetes.

What are the main strengths and weaknesses?

The main strengths of this cohort include its size and the availability of detailed information collected independently of the outcomes under study. Furthermore, we have complete follow-up information on mortality and on specific morbidity outcomes. For many outcomes, information was collected before the date of diagnosis of the disease, thereby ensuring a prospective study design.

The main weakness is that we have had no contact with the cohort members and are therefore unable to obtain information on confounders, such as lifestyle risk factors, other than those mentioned above. To overcome this weakness, we have planned nested case-control studies involving cases and sample controls from our cohort or an external control group, depending on the outcome. Another weakness is that we do not have information on the religious practices of each member, e.g. church attendance, or their beliefs, e.g. the subjective value attached to personal belief. In addition, we have no information on how some people become religious, except for the 22% of Adventists and 38% of Baptists whose parents were members of the same religious community (Table 1). These weaknesses will not affect the mortality and morbidity rates and will therefore tend to lead to non-differential misclassification. A third weakness is that the somewhat lower disease risk in the

cohort will mean a longer time for accumulation of incident cases.

We are aware that the study does not give insight into the impact of 'secular spirituality', as the two religious societies do not represent the majority's spiritual or religious inclinations.⁴⁹ The two societies constitute minority groups in Denmark, with both strong beliefs and regular religious practice. The cohort is nevertheless useful for research on the effect of secularization on religious groups.

Can I get hold of the data?

The investigators would welcome collaboration on specific projects. Further details of the study can be obtained by contacting the Danish Religious Societies Health Study at the Department of Psychosocial Cancer Research, Danish Cancer Institute, Danish Cancer Society, at christof@cancer.dk.

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