Associations between sun exposure and other lifestyle variables in Swedish Women

Running title: Association between sun exposure and other lifestyle factors

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Abstract

Purpose: Sun exposure is associated with risk of several chronic diseases including cancer. The study aim is to investigate whether sun behaviours are related to other lifestyle risk factors of cancer.

Methods: We analysed data collected in 2003-2004 by self-completed questionnaire from 34,402 Swedish women aged 40-61 years, who comprised 70% of a cohort of originally recruited from a population registry in 1991-1992 (n=49,259). Participants were asked about annual number of sunburns and annual number of weeks of swimming and sunbathing during 1991-2002, solarium use during 1991-1998 and current sunscreen use.

Results: Compared to non-drinkers, the prevalence ratio (95% CI) in women who drank >10 g of alcohol per day was 1.64 (1.49, 1.81) for having >1 sunburn per year, 1.39 (1.29, 1.51) for swimming and sunbathing >2.5 weeks per year and 1.55 (1.41, 1.70) for using a solarium >1 time per 2 months, adjusting for demographic and lifestyle variables. Tobacco smokers were less likely to report sunburn and to use sunscreen, and more likely to sunbath and use solaria, compared with non-smokers. Physical activity was associated positively with swimming and sunbathing, and with the separate use of solaria and sunscreens, but not with number of sunburns. The lifestyle variables that explained most of the variation in sun behaviour were alcohol and smoking.

Conclusions: Our results suggest that alcohol consumption and tobacco smoking are potential lifestyle confounders which should be adjusted in studies investigating the association that sun and/or solarium exposure may have with risk of several cancer sites.

Key words: alcohol drinking; exercise; smoking; sunbathing; sunburn; sunscreening agents.

Introduction

Increased sun exposure is an accepted cause of skin cancer (1). However, decreased sun exposure has been proposed as a possible risk factor for other cancers, based on descriptive epidemiology reports showing inverse associations between solar radiation and mortality from a wide range of cancers including breast, colon, ovary, and prostate as well as non-Hodgkin lymphoma (2, 3). Solar radiation in the ultraviolet (UV)-B wavelength (280-315 nm) is the primary determinant of vitamin D status in humans (4). The last decade has seen a great increase in publications on the possible contribution of vitamin D deficiency to the aetiology of a range of cancers including colorectal, breast, prostate and bladder (5-7).

Lifestyle behaviours, such as tobacco smoking, alcohol drinking and physical inactivity, are all factors which modify the risk of chronic diseases (8), including skin cancer (9, 10), yet there has been limited research on their associations with sun behaviour patterns such as exposure to sun-burn, indoor tanning and solarium use, and sunscreen use. Physical activity has been associated with history of sunburn (11, 12) and current sunscreen use (13), but inversely with solarium use (14); tobacco smoking is associated inconsistently with sunscreen use (15, 16) and with sunbed use (16, 17); while consumption of alcohol occurs commonly during outdoor activities (18) and has been associated with the occurrence of sunburn (12, 19).

Previous studies which have reported the association between several lifestyle variables and sun behavior have only examined a single sun behavior such as sun burn (12, 19) or solarium use (14), and have not quantified the relative importance of lifestyle. To fill this gap in knowledge, we decided to examine whether there were any consistent associations between individual lifestyle factors and a range of sun behaviours in a large cohort of Swedish women, and to quantify the variation in sun behaviour associated with lifestyle risk factors to determine which were most important.

Materials and Methods

Survey design and study population

The Swedish Women's Lifestyle and Health (WLH) cohort study enrolled women aged 30-49 years who were selected randomly from the Swedish Central Population Registry held by Statistics Sweden. Out of 96,000 women mailed the baseline questionnaire to their residential address in 1991-1992, 49,258 (51%) returned a completed questionnaire and were enrolled into the Swedish WLH cohort. The recruitment of the study participants and collection of their baseline data have been described previously (20, 21). Repeat lifestyle data were collected in 2003-2004 from 34,402 women (70% of the baseline cohort) alive and still living in Sweden, using a second questionnaire that was either mailed to their homes for completion, or completed on line (22). Women who did not complete the second questionnaire comprised 1,402 who died, 567 who emigrated and 12,888 non-responders (22). Comparisons of baseline data between women who completed the second questionnaire and those who did not showed that the former had a longer education, higher levels of physical activity and alcohol intake, and lower tobacco smoking. The Data Inspection Board in Sweden and the regional Ethical Committee both approved the study, with consent indicated by the completion of the postal or web-based questionnaire. The data in this report come from the second questionnaire completed in 2003-2004, aside from years of education which comes from the baseline 1991-1992 questionnaire. English translations of the baseline and second questionnaires can be downloaded from the following website: http://www.meb.ki.se/~eliwei_2011/wlh/wlh_documents/.

Demographic, Lifestyle and Medical History Variables

The second questionnaire included variables on demographic status (age), current lifestyle (tobacco smoking, alcohol consumption which was converted to g/day, self-rated physical activity) and current anthropometry (self-reported weight and height which were converted to body mass index (BMI) kg/m^2). Years of education were available from the baseline questionnaire. For data on medical history, women were asked in the second questionnaire if they had ever been diagnosed by a doctor as having a heart attack, and whether they currently had diabetes; while data on previous cancer came from the baseline questionnaire when women were asked if they had ever had cancer.

Sun and Solarium Exposure Behaviours

Women were also asked about their sun behaviours during each of following periods: 1991-1994, 1995-1998, and 1999-today (which was calculated as 2002 to give a 4- year period in data analyses). For each of the above four year periods, they were asked: 'How many times per year on average did you get burnt by the sun so that your skin was sore or you had blisters and peeling skin?' (none, 1, 2-3, 4-5, or ≥6 times); 'How many weeks per year on average did you swim and sunbathe in Sweden or another Nordic country?' (none, 1, 2-3, 4-5, or ≥6 weeks); and for the 1991-1994, 1995-1998 periods only, 'How many times per month on average have you been to a solarium?' (never, rarely, 1, 2, 3-4, or ≥5 times). They also were asked about current sunscreen use at the time of interview: 'when you are out in the sun, how often do you use sun screening products when you sunbathe in Sweden or other Nordic countries?' (not at all, sometimes, often).

Statistical Methods

The number of sunburns per year was calculated from the sum of the number in each four year period (1991-1994, 1995-1998, 1999-2002), divided by 12 years. The same method was used to calculate the annual number of weeks swimming and sunbathing in Sweden or any other Nordic country. Solarium use during 1991-1998 was calculated by taking the average times per month for each of the four year periods (numbering 'rarely' as once per 2 months).

Out of the total sample of 34,402 women who completed the second questionnaire, the following numbers had missing information on: years of education 672; tobacco smoking 126, self-rated physical activity 691; BMI 304; sunburn 1,738; swimming and sunbathing weeks 1,096; solarium use 675; and sunscreen use 383.

Data were analysed by fitting log-binomial regression models using the SAS (GENMOD procedure) version 9.4, i.e. modelling the logarithm of the probability of an event conditional on model covariates. Age and education, both categorically, were considered potential confounders and were included in all models. Prevalence ratios and associated two-sided 95% profile likelihood type confidence intervals were calculated by including the categorical factors in the log binomial models. In separate models we tested for interaction effects between smoking and alcohol, smoking and physical activity and between alcohol and physical activity by calculating the likelihood ratio test. All statistical tests were done on the two-sided 5% level of significance. We did not adjust for multiplicity of statistical tests. The goodness of fit of the statistical models was assessed by likelihood-ratio test, which calculates changes in the log-likelihood value when including another covariate.

Results

The total sample of 34,402 women was distributed equally across the four age-bands covering the survey age-range: 40-45 years = 7,698 (22%); 46-50 years = 8,568 (25%); 51-55 years = 8,794 (26%); and 56-61 years = 9,342 (27%).

The associations of individual sun behaviour variables with demographic, lifestyle and medical history variables are shown in Tables 1-4 for two models: adjusting for age and years of education only, and also for all variables.

Annual number of sunburns during 1991-2002 was positively associated with years of education and alcohol drinking, and inversely with age and current tobacco smoking, but was not associated with physical activity, BMI or medical history (Table 1). The X^2 values, which are equal to twice the change in goodness-of-fit from adding a variable to the model, show that age and alcohol explained most of the variation in sunburn, followed by smoking and education.

A slightly different pattern was seen for annual weeks swimming and sunbathing in Sweden or other Nordic country during 1991-2002 (Table 2). This variable was positively associated with tobacco smoking, alcohol drinking and physical activity, and inversely associated with age, education and BMI. From the X^2 values, age explained most of the variation in swimming and sunbathing, followed in descending order by alcohol, physical activity, smoking and years of education. Medical history was not associated with this sun behavior.

Solarium use during 1991-1998 was positively associated with tobacco smoking, alcohol drinking and physical activity, inversely associated with age, education and BMI, but not associated with medical history (Table 3). Years of education explained most of the variation in solarium use, followed in descending order by smoking, alcohol, physical activity and age.

Current sunscreen use in Sweden and other Nordic countries had weak positive associations with alcohol drinking and physical activity, weak negative associations with age, education, tobacco smoking and BMI, but was not associated with medical history (Table 4). The variation in sunscreen use explained by these variables was lower than observed for other sun behaviors (Tables 1-3).

When we examined the overall pattern for all sun behaviors in the full multivariate models, age was associated inversely with all four sun behaviors; while years of education were associated positively with sunburn and negatively with the other three. Of the lifestyle variables, alcohol drinking had the strongest associations with sun behaviours (consistently positive), especially for sunburns and solarium use. Tobacco smoking also had strong associations with sun behaviour, but these were inconsistent being positively associated with weeks of swimming and sunbathing in Nordic countries and solarium use, and inversely associated with sunburn and sunscreen use. Physical activity had positive associations with weeks of swimming and sunbathing in Nordic countries, solarium and sunscreen use, but no association with sunburn. BMI had opposite associations to those for physical activity, with weak inverse associations with solarium and sunscreen use. The prevalence ratios decreased only a little in the full multivariate model compared with the model adjusting for age and education only, indicating that the lifestyle and demographic variables may be independently associated with sun behaviour. From the calculated likelihood ratio tests, we did not find any support for interaction between alcohol and smoking, alcohol and physical activity or between smoking and physical activity.

Discussion

In this large population-based survey of Swedish middle-aged women, alcohol drinking, tobacco smoking and physical activity, as well as age and education all have independent associations with patterns of sun behaviour.

Of the lifestyle variables, alcohol had the strongest associations – specifically, positive linear associations with sunburn, swimming and sunbathing and solarium use, and a non-linear association with sunscreen use. Our findings are consistent with a large US population-based telephone survey which found that alcohol consumption was positively associated with the number of sunburns in the previous 12 months, with odds ratios similar to our survey (19). Another large US population-based survey also reported a positive association between alcohol use and having one or more sunburns in the past 12 months (12). In a small survey severity of sunburn was associated with drinking alcohol while at the beach (23). A combined measure of any substance use (tobacco, alcohol or marihuana) was associated with solarium use among US white adolescents (14). Our study extends these findings to show that alcohol drinking, by itself, is associated specifically also with solarium use, in addition to sunburn and sunbathing; an observation that is consistent with the reduction after drinking alcohol in the minimal dose from exposure to UV light that causes erythema (24).

We observed a different pattern for tobacco smoking compared to that for alcohol drinking. While the latter was associated positively with all four sun behaviours, in contrast, current tobacco smokers were less likely to report sunburn (more than once per year) and to use sunscreen (often), although they also were more likely to sunbath and use solaria. The decreased prevalence of reported sunburn among current smokers suggests that sun behaviours are not associated always with risk taking behaviours. Our sunscreen results are consistent with those from a large US cross-sectional survey in which smoking was associated with reduced sunscreen use (15); and our solaria results are consistent with a French study of middle-aged volunteers which found that smokers were more likely to report lifetime use of a solarium than non-smokers (17). In contrast, a case-control study of skin cancer cases and seborrheic keratosis controls from Sweden found that smoking was not associated with either sunburn occasions or sunbed use, probably because of its relatively small sample size (16); while having one or more sunburns in the past 12 months was not associated with smoking status in a large US survey, after adjusting for covariates (12).

The level of physical activity by women in our study was positively associated with swimming and sunbathing, and with the separate use of solaria and sunscreens, but not with number of sunburns. Our sunburn results are not consistent with previous reports from large population-based surveys in the US and Australia where physical activity was associated with increased risk of sun exposure (11, 12). Nor was our solarium result consistent with an inverse association between physical activity and use of solaria observed in white female adolescents in the US (14). However, women with high physical activity in our study did report more frequent swimming and sunbathing than those who had low activity levels. Physically active women also were more likely to use sunscreens, which may have prevented any increased risk of sunburns in the active group.

Women in our study who were overweight or obese were less likely to use solaria or sunscreens. The solarium result is consistent with the decreased prevalence of high BMI among solarium users, compared to non-users, in the study of US white female adolescents (14). However, in contrast to our study which found no association between BMI and sunburn, the population-based study of US adults reported more frequent sunburns among overweight and obese participants than non-obese. Further research is required on the relationship between BMI and sun behaviours to determine if they are linked, as the associations with BMI in our study were weak, with effect measures all in the range of 5-10% of the reference value of one, which may explain these inconsistent results.

The sun behavior patterns for demographic variables in our study mostly were similar to those reported from cohorts covering a similar age-range. Consistent with our results, previous studies have found that age is associated inversely with sunburn (11, 12, 25) and solarium use (17, 25, 26). In contrast, the association between age and sunscreen use is less clear, with one study reporting decreased use with increasing age (15), as we found, while another Swedish study of younger women found that sunscreen use increased over the age-range of 18-37 years (25). For education, we found that sunbathing and use of solaria or sunscreen decreased with increasing number of educational years, while sunburn increased. Our result of a positive association between education and sunburn is consistent with previous studies (12, 25); as is the negative association between education and solarium use (25). In contrast, previous research has reported that education level is associated positively with sunscreen use (15, 25). Overall, our results indicate that demographic variables, such as age and education, explain much of the variation in sun behavior and their effects need to be considered for adjustment when analysing associations between sun behaviour and lifestyle risk in observational studies.

The strongest effects associated with lifestyle in our study were found for alcohol consumption, which was associated positively with all four sun behaviors, particularly sunburn, sunbathing and solarium use. The consistency of these findings with previous research (described above) increases the likelihood that alcohol drinking is associated with both outdoor and indoor UV exposure. If so, this finding has important implications for studies of sun exposure and skin cancer, as recent metaanalyses of observational studies have found that alcohol consumption is a weak risk factor for both cutaneous melanoma and basal cell carcinoma (9, 27, 28). It is possible that previous skin cancer studies which did not adjust for alcohol consumption may have over-estimated the effect attributed to sun or solarium exposure. Alcohol may have carcinogenic effects through its conversion to acetaldehyde (18), which is a known carcinogen (29). Collectively, these results suggest that future epidemiological studies of UV exposure and skin cancer should adjust for alcohol consumption. The same comment applies to tobacco smoking as this explained significant variation in sunbathing and solarium use (Tables 2 and 3) and may also be associated with skin cancer (10, 30).

Our results are also relevant for studies of vitamin D status and colorectal cancer, because sun exposure is the primary determinant of the main marker of vitamin D status, circulating 25-hydroxyvitamin D (25(OH)D), which has been shown in cohort studies to be inversely associated with increased risk of this cancer (5, 6). Sunburn and sunbathing are likely to be associated with increased 25(OH)D concentrations. Alcohol consumption is associated with both of these sun behaviours, while tobacco smoking and physical activity are associated only with sunbathing. Thus, all three variables – alcohol drinking, tobacco consumption and physical activity – are each a potential confounder of the association between 25(OH)D levels and risk of colorectal cancer. In contrast, the effect of increased solarium use on vitamin D levels is unclear as solaria in Scandinavia during this period used lamps which emitted a mixture of UVB and UVA radiation (31). The potential effect of sunscreen use on vitamin D status is also unclear as it is not consistently associated with decreased 25(OH)D levels, since it can be a marker of sun exposure (which would increase 25(OH)D kevels), and although it should prevent vitamin D synthesis, it is not adequately applied to skin to completely block this (32, 33).

Strengths of this study include its large sample size with sufficient power to detect associations, the use of sun behaviour questions that have criterion validity with regard to the prediction of melanoma and squamous cell carcinoma (34, 35), and the population-based sampling of the original cohort which allows us to extrapolate results to the wider Swedish population of women in the study age-group, although our findings may not apply to men or other age-groups. Other limitations include the cross-sectional data used in analyses, which only can be used to investigate associations between lifestyle and sun behaviour variables, not causation. There also is likely to be error correlating the measurement of lifestyle (at the time of interview) with sun behaviour (recalled for a different time frame from the prior decade). However, given the cross-sectional nature of these data, any measurement error is likely to have been non-differential which would have resulted in attenuation of the associations we observed.

In summary, we have found that alcohol consumption, followed by tobacco smoking, are the main lifestyle variables associated with sun behaviors in a large cohort of middle-aged Swedish women. Our results suggest that both are potential confounders which should be adjusted in epidemiological studies investigating the association that sun or solarium exposure, or vitamin D status, may have with risk of skin and colorectal cancer. Age and education also are potential demographic confounders that need to be considered for adjustment.

Disclosure of Potential Conflicts of Interest

The authors declare that there are no conflicts of interest.

Authors' Contributions

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Acquisition of data (provided animals, acquired and managed patients, provided facilities, etc.): S Sandin, M Löf, H-O Adami, E Weiderpass

Analysis and interpretation of data (e.g., statistical analysis, biostatistics, computational analysis): R Scragg, S Sandin, M Löf, H-O Adami, E Weiderpass

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Administrative, technical, or material support (i.e., reporting or organizing data, constructing databases): S Sandin, M Löf, H-O Adami, E Weiderpass

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Table 1: Associations between annual number of sunburns during 1991-2002 and demographic and lifestyle variables, including the change in goodness-of-fit [a] for each variable.

Variable	Study sample N	Annual number of sunburns (row %)					P-value	Prevalence Ratio (95% CI) of Annual sunburns >1		
		0	>0 -< 1	1	>1 - 2	>2		(row %)	Adjusted for age, education [b]	Adjusted for all variables in table N=30,399
Age (years)										
40 – 45	7,438	14	23	38	14	11		25	1.00	1.00
46 – 50	8,224	17	26	36	12	9	<0.0001	21	0.85 (0.80, 0.90)	0.83 (0.79, 0.88)
51 – 55	8,342	22	29	31	12	7		18	0.75 (0.71, 0.80)	0.74 (0.69, 0.78)
56 – 61	8,660	30	32	24	10	5		14	0.59 (0.55, 0.63)	0.58 (0.54, 0.62)
								X^2 (p-value)[b]	258.46 (<0.0001)	257.97 (<0.0001)
Education (years)										
≤9	5,238	32	29	24	9	6		35	1.00	1.00
10 – 12	12,478	20	28	32	12	8	<0.0001	44	1.22 (1.13, 1.32)	1.16 (1.08, 1.26)
13 – 15	9,354	17	26	35	13	9		51	1.34 (1.24, 1.45)	1.23 (1.13, 1.33)
≥16	4,980	17	27	34	13	8		57	1.33 (1.21, 1.45)	1.20 (1.10, 1.31)
								X^2 (p-value)	55.85 (<0.0001)	26.65 (<0.0001)
Tobacco smoking										
Never	15,158	20	28	33	12	7	<0.0001	48	1.00	1.00
Former	10,603	19	27	32	13	9		48	1.14 (1.08, 1.20)	1.08 (1.02, 1.13)
Current	6,810	26	28	29	10	7		41	0.91 (0.85, 0.97)	0.86 (0.80, 0.91)
								X^2 (p-value)	57.51 (<0.0001)	47.73 (0.0001)
Alcohol drinking (g/d)										
0	3,292	34	26	25	8	6		42	1.00	1.00
>0 – 3	7,165	25	30	29	10	6	<0.0001	45	1.08 (0.98, 1.20)	1.08 (0.98, 1.20)
>3 – 5	6,610	20	28	34	11	7		47	1.22 (1.10, 1.35)	1.23 (1.11, 1.37)
>5 – 10	8,786	17	27	34	13	8		48	1.48 (1.34, 1.62)	1.47 (1.33, 1.62)
>10	6,811	15	26	34	14	10		47	1.63 (1.48, 1.79)	1.64 (1.49, 1.82)
								X^2 (p-value)	222.68 (<0.0001)	212.87 (<0.0001)
Physical activity										
Low	12,315	22	28	31	12	7	<0.0001	44	1.00	1.00
Medium	12,622	20	28	32	12	8		47	1.01 (0.95, 1.06)	0.99 (0.94, 1.04)

High	7,207	19	27	33	12	9		51	1.04 (0.98, 1.10)	1.00 (0.94, 1.06)
								X^2 (p-value)	1.90 (0.39)	0.21 (0.90)
BMI (kg/m^2)										
Normal	16,182	19	28	33	12	8		48	1.00	1.00
Overweight	11,841	21	28	32	11	8	<0.0001	46	0.99 (0.95, 1.04)	0.99 (0.94, 1.04)
Obese	4,399	24	28	29	12	7		43	1.02 (0.96, 1.10)	1.05 (0.98, 1.13)
								X^2 (p-value)	0.41 (0.81)	2.81 (0.24)
Previous cancer [c]										
No	32,242	21	27	32	12	8	0.018	20	1.00	1.00
Yes	422	27	27	27	12	7		19	1.09 (0.89, 1.33)	1.09 (0.88, 1.33)
								X^2 (p-value)	1.11 (0.29)	0.70 (0.40)
Previous heart attack										
No	31,544	21	27	32	12	8	<0.0001	20	1.00	1.00
Yes	246	35	27	22	11	5		15	0.96 (0.71, 1.28)	0.96 (0.69, 1.27)
								X^2 (p-value)	0.27 (0.60)	0.08 (0.78)
Diabetes										
No	31,684	20	28	32	12	8	<0.0001	20	1.00	1.00
Yes	839	30	27	25	11	7		18	0.96 (0.83, 1.12)	1.03 (0.88, 1.20)
								X^2 (p-value)	0.10 (0.75)	0.15 (0.70)

[a] X^2 and p-value correspond to the test statistic and p-value for the likelihood ratio tests for goodness-of-fit.

[b] adjusted for age and/or education, as appropriate. [c] at baseline.

kg: Kilogram, BMI: Body Mass Index (body weight/height(meter)**2), m2: Square meter, g:gram, g/d: Grams per day, N: Number of women.

Table 2: Associations between annual weeks of swimming & sunbathing in Sweden or other Nordic country during 1991-2002 and demographic and lifestyle variables, including the change in goodness-of-fit [a] for each variable.

Variable	Study sample N	Annual weeks swimming & sunbathing (row %)					P-value	Annual weeks >2.5 (row%)	Prevalence Ratio (95% CI)	
		0	>0 - 1	>1 - <2.5	2.5	>2.5			Adjusted for age, education [b]	Adjusted for all variables in table N=30,950
Age (years)										
40 – 45	7,539	6	19	10	32	33		33	1.00	1.00
46 – 50	8,369	9	24	10	30	28	<0.0001	28	0.84 (0.80, 0.88)	0.83 (0.80, 0.88)
51 – 55	8,492	12	27	10	27	24		24	0.72 (0.68, 0.75)	0.71 (0.68, 0.75)
56 – 61	8,906	17	27	9	26	21		21	0.64 (0.61, 0.68)	0.66 (0.62, 0.69)
								X^2 (p-value)	304.69 (<0.0001)	270.88 (<0.0001)
Education (years)										
≤9	5,401	18	24	9	24	25		25	1.00	1.00
10 – 12	12,721	10	24	10	29	27	<0.0001	27	0.98 (0.93, 1.04)	0.97 (0.91, 1.02)
13 – 15	9,515	9	25	9	31	26		26	0.96 (0.90, 1.02)	0.93 (0.87, 0.98)
≥16	5,041	12	27	10	28	24		24	0.90 (0.84, 0.97)	0.86 (0.80, 0.92)
								X^2 (p-value)	20.61 (0.0001)	22.83 (<0.0001)
Tobacco smoking										
Never	15,475	12	27	9	29	23	<0.0001	23	1.00	1.00
Former	10,800	10	23	9	30	28		28	1.20 (1.15, 1.25)	1.17 (1.12, 1.22)
Current	6,933	11	22	11	26	29		29	1.24 (1.19, 1.30)	1.25 (1.19, 1.32)
								X^2 (p-value)	113.86 (<0.0001)	94.28 (<0.0001)
Alcohol drinking (g/d)										
0	3,368	25	26	9	20	20		20	1.00	1.00
>0 – 3	7,310	15	26	10	26	23	<0.0001	23	1.14 (1.05, 1.24)	1.11 (1.02, 1.20)
>3 – 5	6,758	10	26	10	29	26		26	1.26 (1.17, 1.37)	1.22 (1.13, 1.33)
>5 – 10	8,934	7	23	10	31	28		28	1.36 (1.26, 1.47)	1.31 (1.21, 1.42)
>10	6,936	8	22	9	31	30		30	1.48 (1.37, 1.61)	1.40 (1.29, 1.52)
								X^2 (p-value)	163.06 (<0.0001)	111.33 (<0.0001)
Physical activity										
Low	12,560	14	26	10	26	23	<0.0001	23	1.00	1.00
Medium	12,845	10	24	10	29	26		26	1.13 (1.08, 1.18)	1.14 (1.09, 1.19)
High	7,340	8	22	9	31	31		31	1.31 (1.25, 1.37)	1.30 (1.24, 1.37)
								X^2 (p-value)	120.62 (<0.0001)	106.83 (<0.0001)

BMI (kg/m^2)										
Normal	16,495	9	23	10	31	27		27	1.00	1.00
Overweight	12,075	12	25	9	28	25	<0.0001	25	0.93 (0.90, 0.97)	0.97 (0.93, 1.01)
Obese	4,492	19	27	10	21	23		23	0.87 (0.82, 0.92)	0.95 (0.90, 1.01)
								X^2 (p-value)	27.61 (<0.0001)	3.52 (0.17)
Previous cancer [c]										
No	32,870	11	25	10	28	26	0.51	26	1.00	1.00
Yes	436	13	24	11	26	26		26	1.06 (0.90, 1.25)	1.04 (0.87, 1.22)
								X^2 (p-value)	0.24 (0.63)	0.16 (0.69)
Previous heart attack										
No	32,150	11	24	10	29	26	<0.0001	26	1.00	1.00
Yes	249	23	20	13	19	25		25	1.09 (0.88, 1.35)	1.14 (0.91, 1.40)
								X^2 (p-value)	0.91 (0.34)	1.33 (0.25)
Diabetes										
No	32,308	11	24	10	29	26	<0.0001	26	1.00	1.00
Yes	852	25	26	9	17	23		23	0.91 (0.80, 1.03)	0.97 (0.84, 1.10)
								X^2 (p-value)	2.46 (0.12)	0.24 (0.62)

[a] X^2 and p-value correspond to the test statistic and p-value for the likelihood ratio tests for goodness-of-fit.

[b] adjusted for age and/or education, as appropriate.   [c] at baseline.

kg: Kilogram, BMI: Body Mass Index (body weight/height(meter)**2), m2: Square meter, g:gram, g/d: Grams per day, N: Number of women.

Table 3: Associations between solarium exposure during 1991-1998 and demographic and lifestyle variables, including the change in goodness-of-fit [a] for each variable.

Variable	Study sample N	Solarium use (row %)				P-value	Used solarium >1 time per 2 months (row %)	Prevalence Ratio (95% CI)	
		Never	>0 - ≤1.0 times per 2 months	>1 - <4 times per 2 months	≥ 4 times per 2 months			Adjusted for age, education [b]	Adjusted for all variables in table N=31,277
Age (years)									
40 – 45	7,578	41	35	12	11		24	1.00	1.00
46 – 50	8,435	48	35	11	9	<0.0001	21	0.89 (0.84, 0.94)	0.88 (0.83, 0.94)
51 – 55	8,632	46	33	11	9		21	0.89 (0.83, 0.94)	0.89 (0.84, 0.94)
56 – 61	9,082	51	30	10	9		19	0.80 (0.76, 0.86)	0.82 (0.77, 0.87)
							X^2 (p-value)	61.23 (<0.0001)	39.39 (<0.0001)
Education (years)									
≤9	5,539	50	27	11	12		23	1.00	1.00
10 – 12	12,867	443	34	12	11	<0.0001	24	0.94 (0.89, 0.996)	0.94 (0.88, 0.99)
13 – 15	9,596	44	37	11	8		19	0.77 (0.72, 0.82)	0.76 (0.71, 0.81)
≥16	5,085	53	32	9	5		14	0.58 (0.53, 0.63)	0.56 (0.51, 0.61)
							X^2 (p-value)	270.78 (<0.0001)	252.16 (<0.0001)
Tobacco smoking									
Never	15,670	51	32	10	7	<0.0001	17	1.00	1.00
Former	10,939	42	35	12	10		23	1.29 (1.23, 1.36)	1.25 (1.18, 1.31)
Current	7,009	41	32	13	14		26	1.43 (1.36, 1.51)	1.43 (1.36, 1.52)
							X^2 (p-value)	206.43 (<0.0001)	169.86 (<0.0001)
Alcohol drinking (g/d)									
0	3,458	65	20	7	8		15	1.00	1.00
>0 – 3	7,463	52	31	9	9	<0.0001	18	1.20 (1.09, 1.32)	1.16 (1.06, 1.29)
>3 – 5	6,827	45	34	12	9		21	1.42 (1.29, 1.56)	1.37 (1.25, 1.51)
>5 – 10	9,021	40	37	13	10		23	1.55 (1.42, 1.70)	1.46 (1.33, 1.61)
>10	6,958	39	37	13	11		24	1.67 (1.52, 1.83)	1.54 (1.40, 1.70)
							X^2 (p-value)	206.55 (<0.0001)	136.27 (<0.0001)
Physical activity									
Low	12,742	49	31	10	10	<0.0001	20	1.00	1.00
Medium	13,002	45	35	11	9		20	1.02 (0.97, 1.07)	1.03 (0.98, 1.08)
High	7,386	40	35	13	11		24	1.23 (1.17, 1.30)	1.23 (1.16, 1.30)

							X^2 (p-value)	64.18 (<0.0001)	56.92 (<0.0001)
BMI (kg/m^2)									
Normal	16,662	43	35	13	10		22	1.00	1.00
Overweight	12,248	46	33	11	10	<0.0001	21	0.93 (0.89, 0.97)	0.95 (0.91, 1.00)
Obese	4,559	55	25	10	10		19	0.86 (0.80, 0.92)	0.93 (0.87, 1.00)
							X^2 (p-value)	22.83 (<0.0001)	5.51 (0.06)
Previous cancer [c]									
No	33,286	46	33	11	10	0.026	21	1.00	1.00
Yes	441	53	29	9	9		18	0.86 (0.70, 1.06)	0.87 (0.70, 1.07)
							X^2 (p-value)	2.14 (0.14)	1.62 (0.20)
Previous heart attack									
No	32,524	46	33	11	10	0.20	21	1.00	1.00
Yes	253	52	27	11	10		21	0.99 (0.77, 1.27)	1.05 (0.81, 1.33)
							X^2 (p-value)	0.01 (0.93)	0.15 (0.70)
Diabetes									
No	32,702	46	33	11	10	<0.0001	21	1.00	1.00
Yes	872	57	23	9	11		19	0.90 (0.78, 1.03)	0.93 (0.80, 1.08)
							X^2 (p-value)	2.18 (0.14)	0.89 (0.35)

[a] X^2 and p-value correspond to the test statistic and p-value for the likelihood ratio tests for goodness-of-fit.

[b] adjusted for age and/or education, as appropriate.

[c] at baseline.

kg: Kilogram, BMI: Body Mass Index (body weight/height(meter)**2), m2: Square meter, g:gram, g/d: Grams per day, N: Number of women.

Table 4: Associations between current sunscreen use in Sweden & other Nordic countries (reported in 2003-2004) and demographic and lifestyle variables, including the change in goodness-of-fit [a] for each variable.

Variable	Study sample N	Sunscreen use (row %)			P-value	Often (row %)	Prevalence Ratio (95% CI)	
		Not at all	Sometimes	Often			Adjusted for age, education [b]	Adjusted for all variables in table N=31,485
Age (years)								
40 – 45	7,635	21	50	29		29	1.00	1.00
46 – 50	8,488	23	50	28	<0.0001	28	0.95 (0.90, 0.99)	0.95 (0.90, 1.00)
51 – 55	8,684	24	48	29		29	0.99 (0.94, 1.04)	0.99 (0.94, 1.04)
56 – 61	9,194	26	47	27		27	0.94 (0.90, 0.99)	0.93 (0.89, 0.98)
						X^2 (p-value)	11.04 (0.012)	9.69 (0.021)
Education (years)								
≤9	5,630	27	45	28		28	1.00	1.00
10 – 12	12,979	23	48	29	<0.0001	29	1.02 (0.97, 1.07)	0.99 (0.94, 1.04)
13 – 15	9,638	22	50	28		28	0.98 (0.93, 1.04)	0.94 (0.89, 0.99)
≥16	5,101	24	50	27		27	0.94 (0.88, 1.00)	0.88 (0.83, 0.94)
						X^2 (p-value)	8.79 (0.032)	20.98 (0.0001)
Tobacco smoking								
Never	15,789	31	50	29	<0.0001	29	1.00	1.00
Former	11,013	23	48	29		29	0.98 (0.94, 1.02)	0.99 (0.95, 1.03)
Current	7,088	21	45	24		24	0.82 (0.78, 0.86)	0.84 (0.80, 0.88)
						X^2 (p-value)	70.01 (<0.0001)	53.38 (<0.0001)
Alcohol drinking (g/d)								
0	3,479	31	43	26		26	1.00	1.00
>0 – 3	7,508	24	46	30	<0.0001	30	1.16 (1.08, 1.24)	1.17 (1.09, 1.26)
>3 – 5	6,893	21	49	29		29	1.14 (1.06, 1.22)	1.15 (1.07, 1.24)
>5 – 10	9,083	21	50	29		29	1.13 (1.06, 1.21)	1.13 (1.06, 1.22)
>10	7,038	24	51	25		25	1.00 (0.93, 1.08)	1.02 (0.94, 1.10)
						X^2 (p-value)	47.97 (<0.0001)	42.78 (<0.0001)
Physical activity								
Low	12,828	26	48	26	<0.0001	26	1.00	1.00
Medium	13,077	22	50	29		29	1.09 (1.05, 1.14)	1.07 (1.03, 1.12)
High	7,475	22	48	31		31	1.17 (1.12, 1.23)	1.13 (1.08, 1.18)
						X^2 (p-value)	48.73 (<0.0001)	25.55 (<0.0001)

BMI (kg/m^2)								
Normal	16,797	22	49	29	0.06	29	1.00	1.00
Overweight	12,343	23	48	28		28	0.97 (0.94, 1.01)	0.98 (0.94, 1.02)
Obese	4,595	28	47	25		25	0.88 (0.83, 0.93)	0.91 (0.85, 0.96)
						X^2 (p-value)	20.36 (<0.0001)	10.72 (0.005)
Previous cancer [b]								
No	33,554	23	49	28	0.52	28	1.00	1.00
Yes	447	23	46	31		31	1.10 (0.95, 1.26)	1.07(0.91, 1.23)
						X^2 (p-value)	1.30 (0.25)	0.64 (0.43)
Previous heart attack								
No	32,768	23	49	28	0.27	28	1.00	1.00
Yes	258	27	44	29		29	1.02 (0.84, 1.25)	1.05 (0.85, 1.28)
						X^2 (p-value)	0.10 (0.75)	0.25 (0.62)
Diabetes								
No	32,953	23	49	28	<0.0001	28	1.00	1.00
Yes	875	31	43	26		26	0.92 (0.82, 1.03)	1.02 (0.90, 1.14)
						X^2 (p-value)	0.79 (0.37)	0.08 (0.77)

[a] X^2 and p-value correspond to the test statistic and p-value for the likelihood ratio tests for goodness-of-fit.

[b] adjusted for age and/or education, as appropriate. [c] at baseline.

kg: Kilogram, BMI: Body Mass Index (body weight/height(meter)**2), m2: Square meter, g:gram, g/d: Grams per day, N: Number of women.t