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Combined impact of healthy lifestyle factors on risk of atrial fibrillation: Prospective study in men and women

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ABSTRACT

Background: The combined impact of multiple lifestyle factors on risk of atrial fibrillation (AF) remains unclear. We investigated the joint association of four modifiable lifestyle factors on incidence of AF in a prospective study of men and women.

Methods: The study cohort comprised 39 300 men in the Cohort of Swedish Men and 33 090 women in the Swedish Mammography Cohort who were 45–83 years of age and free from atrial fibrillation at baseline. Healthy lifestyle was defined as body mass index <25 kg/m^2, regular exercise for ≥20 min/day, no or light-to-moderate alcohol consumption (≤2 drinks/day for men and ≤1 drink/day for women), and not smoking. Incident AF cases were identified through linkage with the Swedish National Inpatient Register.

Results: During a mean follow-up of 10.9 years, AF occurred in 4028 men and 2539 women. Compared with men and women with no healthy lifestyle factors, the multivariable relative risks (95% confidence interval) of AF were 0.83 (0.65–1.07) for one, 0.74 (0.58–0.94) for two, 0.62 (0.49–0.79) for three, and 0.50 (0.39–0.64) for four healthy lifestyle factors (*P* for trend <0.0001). The inverse association was similar in men and women.

Conclusions: Four healthy lifestyle factors combined were associated with a halving of the risk of AF.

1. Introduction

Atrial fibrillation (AF) is the most common cardiac arrhythmia and is associated with significant health care costs [1]. Individuals with AF are at considerably increased risk of various diseases, including stroke, heart failure, and dementia [2,3]. Given the high economic burden of AF and the serious complications of the disease, primary prevention of AF is of great importance. However, relatively little research has been directed at AF prevention [2]. Although some modifiable lifestyle factors such as physical activity [4–6], obesity [2,7,8], smoking [2], and alcohol consumption [9] have been associated with risk of AF, the combined impact of multiple modifiable lifestyle behaviors on AF risk remains unclear.

We aimed to assess the separate and joint association of four modifiable lifestyle factors, including body mass index (BMI), regular exercise, alcohol consumption, and smoking, with AF incidence in a large prospective study.

2. Methods

2.1. Study population

We used data from two prospective cohort studies of Swedish men (Cohort of Swedish Men) and women (Swedish Mammography Cohort). During the late autumn of 1997, 48850 men who were born between 1918 and 1952 and residedinVästmanland and Örebro counties and 39,227 women who were born between 1914 and 1948 and lived in Västmanland and Uppsala counties completed a mailed 350-item questionnaire about lifestyle and other risk factors for non-communicable disease. The present study was approved by the Regional Ethical Review Board at Karolinska Institutet in Stockholm, Sweden.

2.2. Assessment of lifestyle and other factors

Through a self-administered questionnaire mailed to participants during the autumn of 1997, we obtained information on education, physical activity, weight, height, smoking, history of hypertension and diabetes, family history of myocardial infarction before 60 years of age, and alcohol consumption. Cardiac disease was defined as a diagnosis of ischemic heart disease or heart failure in the Swedish National Inpatient Register. We classified participants as having hypertension and diabetes if they reported in the questionnaire that they had any of these diseases or if they had a diagnosis of hypertension or diabetes in the Swedish registries. In the questionnaire, participants were asked to indicate their time spent on walking/bicycling; participants could choose from 6 predefined categories: almost never, <20 min/day, 20–40 min/day, 40–60 min/day, 1–1.5 h/day, or ≥1.5 h/day. We calculated BMI as body weight (in kg) divided by the square of height (in m). Alcohol (ethanol) consumption, in the last year, was computed by multiplying the frequency of consumption of beer, wine, and liquor by the amount consumed at each occasion.

2.3. Definition of healthy lifestyle

We analyzed four pre-specified modifiable lifestyle factors, including BMI, regular exercise, alcohol consumption, and smoking. A healthy lifestyle score was created by dichotomizing each lifestyle factor into a predefined healthy lifestyle alternative and a less healthy behavior: BMI [10] (<25 kg/m^2 versus ≥25 kg/m^2 [overweight]); regular exercise during the last year defined as walking or bicycling at least 20 min/day versus <20 min/day [4,6]; alcohol consumption [9,11] (no or light-to-moderate alcohol

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consumption [≤2 drinks/day for men and ≤1 drink/day for women] versus high consumption); and smoking [12] (not smoking [never and past] versus current smoking). The allocated points of lifestyle factors were combined to create a healthy lifestyle score that ranged from 0 (no adherence to the healthy lifestyle) to 4 (full adherence).

2.4. Ascertainment of cases

Information on dates of diagnosis of AF was obtained through linkage of study participants, using the unique personal identification number assigned to each Swedish citizen, with the Swedish National Inpatient Register. Diagnoses in the Inpatient Register are coded according to the Swedish International Classification of Disease (ICD) system. AF was defined as a trial fibrillation or a trial flutter (ICD-10 code I48). A validation study of the diagnoses of AF in the Swedish Inpatient Register showed that diagnosis of AF is correct in 97% of the cases [13].

2.5. Analytic cohort

We excluded men and women with an erroneous or a missing personal identification number ($n = 297$ men and $n = 243$ women), those with a prior diagnosis of AF ($n = 1496$ men and $n = 634$ women) or cancer except non-melanoma skin cancer ($n = 2592$ men and $n = 1811$ women), and those who died between the administration of the questionnaire and start of follow-up (January 1, 1998; $n = 55$ men and $n = 26$ women). Furthermore, we excluded men and women with missing data on any of the four lifestyle factors ($n = 5110$ men and $n = 3423$ women). This left 39 300 men, 45–79 years of age, and 33 090 women, 49–83 years of age, for the present analysis.

2.6. Statistical methods

Participants were followed up from January 1, 1998 until the date of diagnosis of AF, death (ascertained through linkage to the Swedish Death Register) or end of follow-up (December 31, 2009), whichever occurred first. We used Cox proportional hazards regression models, stratified by age (in months) and sex, to estimate relative risks (RR) with 95% confidence intervals (CI). In addition to age and sex, all multivariable models were adjusted for education (less than high school, high school, or university), family history of myocardial infarction before 60 years of age (yes, no), history of diabetes (yes, no), and cardiac disease (diagnosis of ischemic heart disease or heart failure; yes, no).

We conducted sensitivity analyses in which we excluded cases diagnosed during the first three and five years of follow-up. In another sensitivity analysis we adjusted for history of hypertension, which is a potential intermediate of the association between a healthy lifestyle and AF risk. We evaluated whether the association between a healthy lifestyle and AF was modified by history of cardiac disease, and tested the significance of the interaction by using the likelihood ratio test to compare models with and without interaction terms. All statistical analyses were conducted using SAS (version 9.3; SAS Institute, Cary, NC). Two-sided P-values <0.05 were considered statistically significant.

3. Results

Baseline characteristics of study participants by number of healthy lifestyle factors are shown in Table 1. Those who had all four healthy lifestyle factors, compared with those with none, were older and were more likely to have a postsecondary education but less likely to have a family history of myocardial infarction and a history of cardiac disease, hypertension, and diabetes.

Over a mean follow-up of 10.9 years, AF developed in 4028 men during 422,950 person-years (95 cases per 10 000 person-years) and in 2539 women during 366914 person-years (69 cases per 10 000 person-years). In both men and women, the risk of AF decreased in a dose–response manner with increasing number of healthy lifestyle factors (Table 2). Results from the age- and sex-adjusted model were similar to those from the multivariable-adjusted model. Compared with men and women with no indicator of a healthy lifestyle, those with all four factors had a 50% (95% CI 36% to 61%) lower risk of AF after adjustment for other risk factors. Additional adjustment for a history of hypertension, which is a potential intermediate, did not alter the results appreciably (four lifestyle factors versus none: RR 0.53; 95% CI 0.42–0.68). The results remained essentially the same after excluding incident AF cases diagnosed during the first three years (RR 0.53; 95% CI 0.40–0.69) and five years (RR 0.56; 95% CI 0.42–0.76) of follow-up. The association between a healthy lifestyle and AF was not modified by history of cardiac disease (P for interaction = 0.39).

We next examined the separate and joint association of different combinations of the four healthy lifestyle factors with AF risk (Fig. 1). Low BMI, regular walking/bicycling, and light or no alcohol consumption were associated with a statistically significant reduced risk of AF, with the most pronounced reduction in AF risk observed for a low BMI. Abstinence from smoking was not significantly associated with risk of AF. Combinations that included BMI conferred the greatest reduction in AF risk.

Table 1
Age-standardized baseline characteristics of 39 300 men in the Cohort of Swedish Men and 33 090 women in the Swedish Mammography Cohort by number of healthy lifestyle factors.

		No. of healthy lifestyle factors				
Characteristics[a]	All participants	0	1	2	3	4
Men, n (%)	39 300 (100)	552 (1.4)	3976 (10.1)	11 690 (29.7)	15 233 (38.8)	7849 (20.0)
Age, y	60	56	58	59	60	61
Postsecondary education, %	17	14	14	15	17	22
Family history of MI, %	15	16	16	16	15	13
History of cardiac disease, %	9.3	10	10	11	9.1	7.4
Historyof hypertension, %	24	38	29	28	24	16
Historyof diabetes, %	9.2	13	12	10	9.2	6.4
BMI, kg/m^2	26	28	28	27	26	23
BMI <25 kg/m^2, %	44	0	10	20	44	100
Walking/bicycling ≥20 min/day, %	62	0	14	36	77	100
Nonsmoker, %	75	0	27	65	86	100
Alcohol intake, drinks/day[b]	1.1	3.1	1.9	1.3	0.9	0.8
Alcohol intake ≤ 2 drinks/day, %	84	0	48	79	94	100
Women, n (%)	33 090 (100)	209 (0.6)	1928 (5.8)	8018 (24.2)	13821 (41.8)	9114 (27.6)
Age, y	61	57	59	61	62	62
Postsecondary education, %	20	18	17	18	19	23
Family history of MI, %	17	18	20	18	17	15
History of cardiac disease, %	4.2	5.0	6.3	5.3	3.9	3.2
Historyof hypertension, %	21	22	24	24	22	15
Historyof diabetes, %	4.4	5.7	6.6	6.0	4.3	2.8
BMI, kg/m^2	25	28	28	27	25	22
BMI <25 kg/m^2, %	56	0	15	28	50	100
Walking/bicycling ≥ 20 min/day, %	70	0	16	36	79	100
Nonsmoker, %	77	0	18	59	80	100
Alcohol intake, drinks/day[b]	0.5	1.8	1.1	0.7	0.5	0.4
Alcohol intake ≤ 1 drink/day, %	87	0	51	77	90	100

Abbreviations: BMI, body mass index (calculated as weight in kilograms divided by height in meters squared); MI, myocardial infarction.
[a] Values are means if not otherwise indicated.
[b] Among current drinkers.