Atrial fibrillation in female endurance athletes

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Physical activity (PA) and exercise have been associated with the risk of atrial fibrillation (AF) in a U-shaped manner (1). While moderate PA may reduce the risk, the highest prevalence of AF is observed in sedentary individuals, and amongst middle-aged male endurance athletes (2). Characteristic for these athletes is that AF occurs in the absence of structural heart diseases and other established AF risk factors, suggesting prolonged and vigorous endurance exercise may be a causal factor for AF, and the 'athlete's heart' is a proarrhythmic condition (3). However, the pathophysiological mechanisms for AF in athletes are not fully understood (4). Female athletes have been underrepresented in previous studies and the role of female sex in the association between PA, exercise and AF remains unclear. We aimed to

study the prevalence of AF amongst older female competitive athletes with a history of prolonged exposure to endurance sports.

We conducted a prospective cohort study comprising Norwegian non-elite participants aged ≥65 years in the cross-country (XC) ski competition 'The Birkebeiner race', and individuals of the same age group (65-74 years) attending the population-based Tromsø Study. We have described the methods of the study and reported the risk of AF amongst the male participants previously (2). AF and all reported covariates were self-reported by questionnaires at baseline (2009-2010) and during follow-up surveys (2014, 2020). We report cumulative prevalence of AF, defined as self-reported AF at least once during the study period among participants still alive at follow-up, divided by all participants who attended the baseline survey and were still alive at follow-up. We report continuous variables as means (standard deviations) and categorical variables as percentages. The study was approved by the Health Research Ethics Committee (REK: 2020-175586). All participants gave informed consent to participate.

Out of 51 invited female XC-skiers and 1799 non-athletes, 46 (90%) and 1375 (74%) participated in the study. Table 1 shows baseline characteristics. Female athletes reported a median exposure to endurance exercise of 26 years, and had completed the Birkebeiner XC-race for a median of 9 years. One athlete (2%) and 97 non-athletes (7%) died during follow-up. During the 10-year follow-up period, 7 out of 46 athletes reported AF. The cumulative prevalence of AF was 15.6% (95% CI 6.4-29.4) and 10.3% (8.7-12.1) in female athletes and non-athletes, respectively. Cumulative prevalence for AF in female and male athletes and non-athletes are shown in Figure 1. Three athletes reported other cardiac conditions than AF, and another three suffered a stroke.

Despite a low prevalence of other cardiac conditions and established AF risk factors, the cumulative prevalence of AF in older female athletes was relatively high. We did not observe a statistically significant difference in AF prevalence between athletes and non-athletes. Notably, none of the athletes with AF suffered a stroke and the mortality was low. Although not fully explained, exercise-induced cardiac remodeling (EICR), such as left atrial enlargement, is amongst the suspected underlying mechanisms for exercise-induced AF (5). For unknown reasons, EICR appears to have different characteristics in female compared to male athletes of younger ages (6). AF in female endurance athletes have been only sparsely studied (7), and future studies should aim to address how EICR and potential sex differences may be associated with the risk of AF in female and male athletes. The low number of female athletes in our study is a main limitation, but reflects female underrepresentation in endurance sports competitions. The self-reporting of AF and other covariates is another limitation.

In conclusion, we found a relatively high prevalence of AF in older female athletes with prolonged exposure to endurance sport, but the prevalence of AF did not differ between athletes and non-athletes. Studies with better representation of female athletes are needed to address sex differences in pathophysiological mechanisms underlying EICR and exercise-associated AF.

Figure 1.

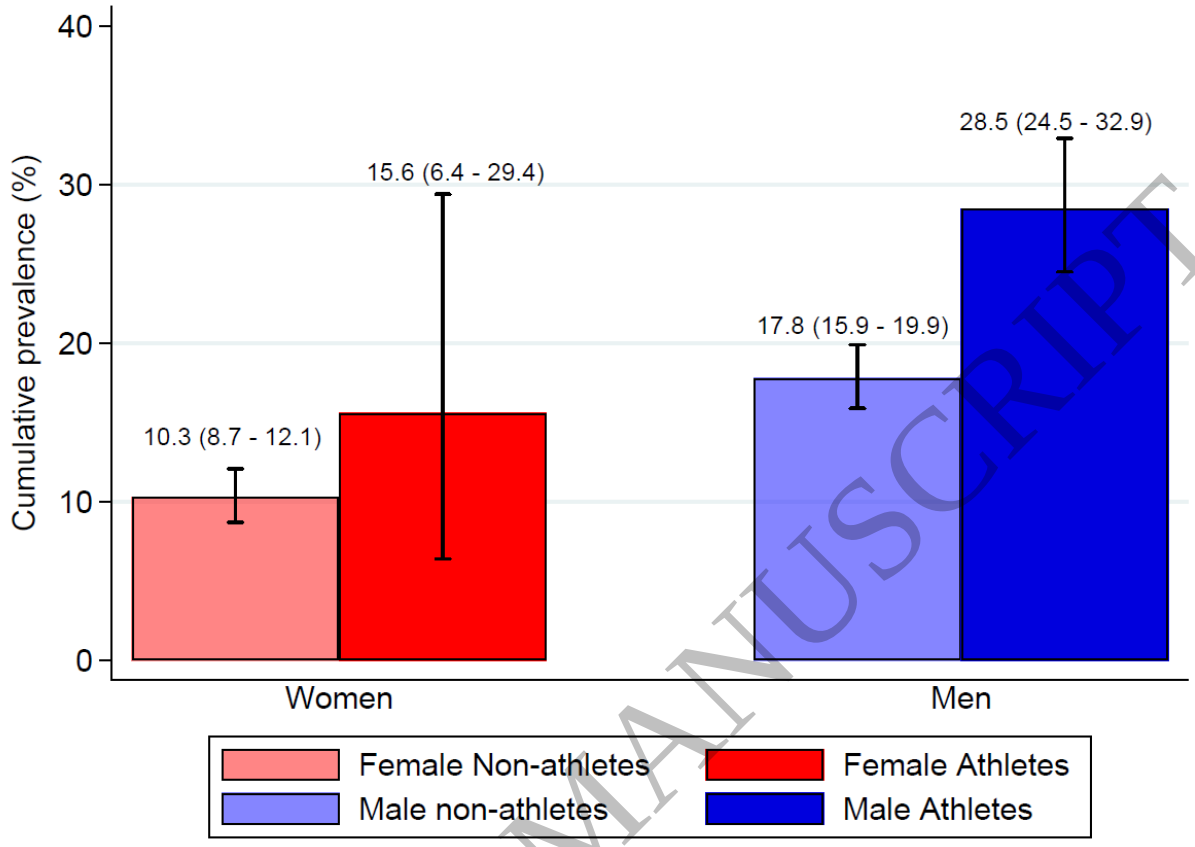

Figure legend:

Cumulative prevalence of atrial fibrillation with 95% confidence intervals in older female and male cross-country skiers during 10-year follow up, and in non-athletes of the same age participating in the Tromsø Study, based on current and previous analyses (2).

Table 1.

Baseline characteristics of female athletes and non-athletes.

Baseline characteristics	Athletes (n=46)	Non-athletes (n=1375)
Age, years	67.5 (2.2)	68.8 (2.8)
BMI, $kg \cdot m^{-2}$	22.0 (1.7)	27.1 (4.7)
Overweight participants	4 (8.9)	571 (41.6)
Obese participants	0 (0.0)	317 (23.1)
Coronary heart disease	1 (2.3)	140 (10.3)
Previous stroke	0 (0.0)	52 (3.9)
Diabetes mellitus	1 (2.4)	104 (7.7)
Currently or previously antihypertensive medication	9 (21.4)	557 (41.2)
Currently or previously lipid lowering medication	6 (14.6)	378 (28.3)
University educated	25 (55.6)	247 (18.4)
Current smoker	0 (0.0)	221 (16.5)
Frequency of alcohol consumption		
>Once per month	31 (73.8)	559 (41.9)
Leisure time physical activity		
Sedentary	0 (0.0)	219 (19.4)
Light activity	6 (14.3)	809 (71.5)
Moderate	23 (54.8)	103 (9.1)
Vigorous	13 (31.0)	1 (0.1)

Means (standard deviation) for continuous and as numbers (percentage) for categorical variables. Except from coronary heart disease, previous stroke, diabetes mellitus and lipid-lowering drugs, all differences were statistically significant ($p<0.05$, parametric t-tests or $\chi 2$ test).

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Data Availability Statement

Data from The Birkebeiner Study may by shared upon reasonable request to the corresponding author. Data underlying this article were provided by the Tromsø study by permission and may be shared with permission.

Author's contributions

Authorship: MM and AHR contributed to the conception, design and acquisition of the work. All authors contributed to the analysis, or interpretation of data for the work. MM and KRJ drafted the manuscript. All critically revised the manuscript, gave final approval, and agree to be accountable for all aspects of work ensuring integrity and accuracy.

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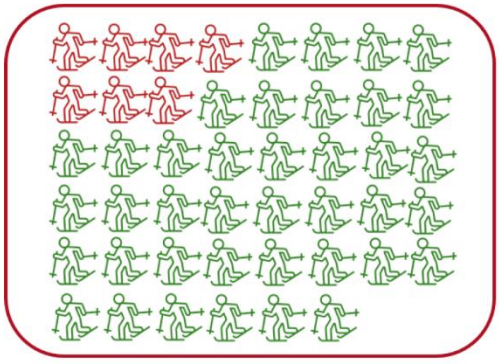
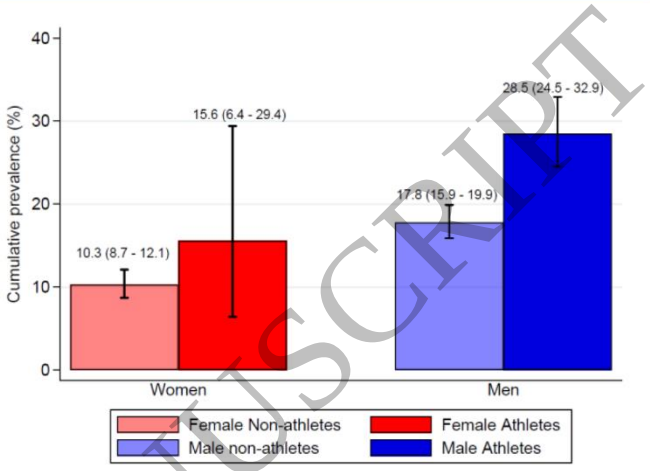
Prolonged vigorous endurance exercise is associated with increased risk of atrial fibrillation in middle-aged and older male athletes, but few studies have reported prevalence of atrial fibrillation in female endurance athletes



Cumulative prevalence of atrial fibrillation of 16% during 10 years follow-up of older recrational female cross-country skiers



The cumulative prevalence of atrial fibrillation among older recreational female endurance athletes was high compared to less active women of the same age-group, but lower than in male endurance athletes. The study suggests that vigorous endurance sport practice may also be a risk factor for AF in female athletes.

Graphical Abstract
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