Athlete and atrial fibrillation

Athletes with atrial fibrillation are probably unlikely to have comorbidities. The population subset with these findings is generally men who are younger than age 60 with normal findings on physical examinations, chest x-ray scans, electrocardiograms, and echocardiographic investigations—criteria for the condition previously termed lone atrial fibrillation.
Clinical characteristics of sport-related atrial fibrillation

The typical clinical profile of sport-related AF or atrial flutter is a middle-aged man (in his forties or fifties) who has been involved in regular endurance sport practice since his youth (soccer, cycling, jogging, and swimming), and is still active. This physical activity is his favourite leisure time activity and he is psychologically very dependent on it.

The AF is usually paroxysmal with crisis, initially very occasional and self-limited, and progressively increasing in duration. Characteristically, AF episodes occur at night or after meals. As many as 70% of patients may suffer predominantly vagal AF. They almost never occur during exercise. This makes the patient reluctant to accept a relationship between the arrhythmia and sport practice, particularly since his physical condition is usually very good. The crises typically become more frequent and prolonged over the years and AF becomes persistent. Progression to permanent AF has been described in 17% of individuals in an observational series. In the GIRAF study, 43% presented persistent AF. The AF crisis frequently coexists with common atrial flutter in many patients.

Mont L et al. Europace 2009;11:11-17
Atrial fibrillation and atrial flutter in athletes


Table 1  Summary of the published studies analysing the relationship between atrial fibrillation and atrial flutter and endurance sport practice

<table>
<thead>
<tr>
<th>Studies</th>
<th>Type of study</th>
<th>% Male</th>
<th>Age (years)</th>
<th>Type of sports</th>
<th>Cease/controls</th>
<th>Prevalence of AF (%) (patients/controls)</th>
<th>Relative risk for AF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Koistinen et al.</td>
<td>Longitudinal case/control</td>
<td>100</td>
<td>47±3 runners</td>
<td>Orienteering</td>
<td>262/373</td>
<td>5.3 (95% CI 1.3 to 24.4)</td>
<td>5.5 (p = 0.012)</td>
</tr>
<tr>
<td>Mort et al.</td>
<td>Retrospective/compared to general population</td>
<td>100</td>
<td>44±13 sports</td>
<td>Endurance sports &gt;3 h/week</td>
<td>70 LAF</td>
<td>63.1 (p = 0.05)</td>
<td>N/A</td>
</tr>
<tr>
<td>Elisseu et al.</td>
<td>Retrospective case/control</td>
<td>100</td>
<td>41±13 non-sports</td>
<td>Current practice and &gt;1500 current hours of practice</td>
<td>32/14 (p = 0.01)</td>
<td>2.67 (95% CI 1.20 to 6.91)</td>
<td></td>
</tr>
<tr>
<td>Hollobach et al.</td>
<td>Case/control in patients undergoing flutter ablation</td>
<td>83</td>
<td>53±5 sports</td>
<td>Cycling, running or swimming &gt;3 h/week</td>
<td>1.91 (1.10–2.98)</td>
<td>5.7 (p = 0.01)</td>
<td>6.80 (95% CI 1.2 to 61.2)</td>
</tr>
<tr>
<td>OBo et al.</td>
<td>Cycling, running or swimming &gt;3 h/week</td>
<td>106</td>
<td>81±10 controls</td>
<td>1.91 (1.10–2.98)</td>
<td>1.91 (1.10–2.98)</td>
<td>5.7 (p = 0.01)</td>
<td>6.80 (95% CI 1.2 to 61.2)</td>
</tr>
<tr>
<td>Moline et al.</td>
<td>Longitudinal case/control</td>
<td>100</td>
<td>39±6 runners</td>
<td>Marathon running</td>
<td>232/305</td>
<td>5.7 (p = 0.01)</td>
<td>8.80 (95% CI 1.2 to 61.2)</td>
</tr>
<tr>
<td>Bartelsberger et al.</td>
<td>Longitudinal case/control</td>
<td>100</td>
<td>67±12 cyclist</td>
<td>Cycling</td>
<td>134/62</td>
<td>10.0 (p = 0.028)</td>
<td>N/A</td>
</tr>
<tr>
<td>Mort et al. GIRAPA study</td>
<td>Longitudinal case/control</td>
<td>69</td>
<td>48±11 Endurance sports</td>
<td>102/107</td>
<td>10.0 (p = 0.028)</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Grimeau et al.</td>
<td>Prospective</td>
<td>100</td>
<td>Group I, 54±2; group II, 72±2; group III, 67–92</td>
<td>Cross-country skiers</td>
<td>Group I, 33; group II, 37; group III, 8</td>
<td>12.2% of LAF</td>
<td>Long QG (p = 0.31, p &lt; 0.001) and QG (p = 0.31, p = 0.012), bradycardia (p = 0.25, p = 0.02), vocal activity (p = 0.002), PAC (p = 0.025) increased in high training group.</td>
</tr>
<tr>
<td>Wijnhuij et al.</td>
<td>Retrospective</td>
<td>100</td>
<td>42±7 Running</td>
<td>70 cases, stratified according to lifetime training hours: low-training group; &lt;1500 h; medium-training group;1500–4500 h; high-training group;&gt;4500 h</td>
<td>70 LAF</td>
<td>6.7%</td>
<td>Signal-averaged P-wave duration (p = 0.002), LA volume (p = 0.001), vocal activity (p = 0.002), PAC (p = 0.025)</td>
</tr>
</tbody>
</table>

LA, left atrial; PAC, premature atrial contractions.
Endurance sport practice as a risk factor for atrial fibrillation and atrial flutter

Europace (2009) 11, 11–17

Fig. 2. Kaplan-Meier curves showing development of AF in 19 patients who continued endurance sports after ablation, vs. 118 patients who did not.
Atrial fibrillation is associated with stroke in veteran endurance athletes

Myrstad M European Heart Journal 2015;36(Suppl. 1):988

**Results:** In total, 2081 male veteran skiers aged 53–74 years were included in this analysis (mean age 62.8 years). The prevalence of self-reported AF was 13%. The prevalence of stroke was 11% in skiers with confirmed AF (n=112), compared to 4% in skiers without AF (p<0.01).

Among skiers with lone AF (n=70), the prevalence of stroke was 11% and lone AF was associated with an OR for stroke of 2.89 (CI 1.15–7.25).

**Conclusions:** This study demonstrates a high prevalence of stroke among veteran endurance athletes with AF. AF was associated with a two to three-fold increased risk of stroke, also in skiers without co-morbid conditions. Our results challenge the favourable prognosis suggested for lone AF and support that veteran athletes with AF should be treated with OAC in line with general guidelines.
Endurance sport practice as a risk factor for atrial fibrillation and atrial flutter

Europace (2009) 11, 11–17

Figure 4 Twenty-four hours recording of heart rate showing a nocturnal episode of atrial fibrillation.
INCREMENTO DEL TONO VAGALE

Bradicardia  < Velocità di Conduzione  < Refrattarietà  < Dispersione Refrattarietà

Figura 2. Modificazioni neurovegetative a livello atriale nel cuore d’atleta.
Endurance sport practice as a risk factor for atrial fibrillation and atrial flutter

Europace (2009) 11, 11–17

**Figure 3** Classical triangle of Coumel suggesting possible etiopathogenic factors influencing the development of atrial fibrillation in athletes.
The controversial relationship between exercise and atrial fibrillation: clinical studies and pathophysiological mechanisms
Flavio D’Ascenzi, Matteo Camelia, Marco M. Ciccone, Maria Maiello, Pietro A. Modesti, Sergio Mondillo, Maria L. Muiesan, Pietro Scicchitano, Salvatore Novo, Pasquale Palmiero, Pier S. Sabag, Roberto Pedrinelli,
on behalf of Gruppo di Studio Ipertensione, Prevenzione e Riabilitazione, Società Italiana di Cardiologia
J Cardiovasc Med 2015, 16:802–810

Possible etiopathogenic factors contributing to atrial fibrillation in athletes. This figure reports the possible triggers, modulators, and substrates involved in the development of atrial fibrillation in athletes. Note that atrial fibrosis and atrial dilatation induced by pressure overload have not been included, according to the scant data available in humans. The term atrial ‘dilatation’ has been replaced by atrial ‘enlargement’ in order to underline the physiological benign meaning of atrial remodeling in athletes.
Atrial Fibrillation Promotion by Endurance Exercise Demonstration and Mechanistic Exploration in an Animal Model

J Am Coll Cardiol 2013;62:68-77
Atrial Fibrillation Promotion by Endurance Exercise Demonstration and Mechanistic Exploration in an Animal Model

J Am Coll Cardiol 2013;62:68-77
Atrial Fibrillation Promotion by Endurance Exercise Demonstration and Mechanistic Exploration in an Animal Model

J Am Coll Cardiol 2013;62:68-77
Nonelite men athletes (marathon and nonmarathon runners) scheduled to participate in the 2010 Grand Prix of Bern, a 10-mile race, were invited.

**Conclusion:** in nonelite men athletes lifetime training hours are associated with prolongation of signal-averaged P-wave duration and an increase in left atrial volume. The altered left atrial substrate may facilitate occurrence of AF. Increased vagal tone and atrial ectopy may serve as modifying and triggering factors.
Are years of training an independent predictor of atrial fibrillation in older runners?

Nair S et al. JACC 2015 65:10 Suppl. 1(A294)

Data regarding medical history and training characteristics were assessed for 2819 runners and endurance athletes.

The mean age of the cohort was 48.4yrs (range 35-90yrs). The median range of running career duration was 11-15 years. AF was reported by 69/2819 respondents (2.4%). There was a significant correlation between accumulated years running and % of runners reporting AF (p<0.001).

In a multivariable logistic regression model years of accumulated running (OR 1.162, 95% CI 1.002-1.348, p=0.047) remained independent predictors of AF. In contrast average running pace, use of speed training, and participation in marathons/ultramarathons did not independently predict AF.

Importantly, the relationship of years of running to AF appears to not be simply related to chronologic age. Physicians should consider the risk of AF in long-term endurance sport participants regardless of athlete age and traditional AF risk factors.
Figure 1  Percentage (95% CI) of participants with lone AF (cases) according to accumulated high-intensity physical exercise (local likelihood regression). Of note, proportion is dependent on cases/control matching in a specific study sample; in our study (2:1 matching), a percentage of 66% would indicate lack of association between exercise and AF.
New Study Shows Save Levels of Exercise Differ For Men and Women With Atrial Fibrillation

Heart Rhythm Society May 15, 2015

The study involved a meta-analysis of 14 prospective observational studies including approximately 379,884 patients. Studies were included if they evaluated trials that reported a relation between incident AF and the level of intensity of exercise.

Among men, vigorous exercise was associated with a 90 percent (1.9 times) increased risk of AF, while moderate exercise lowered the incidence of AF by 19 percent. In women, both moderate and high intensity levels of exercise were found to be beneficial. Moderate exercise reduced the risk of AF in women by 24 percent and by 15 percent when they participated in vigorous exercises.
New Study Shows Save Levels of Exercise Differ For Men and Women With Atrial Fibrillation

Heart Rhythm Society May 15, 2015

Risk
atrial fibrillation

+ moderate exercise

- 19 %
men

- 24 %
women

+ 90 %
men

- 15 %
women

vigoroues exercise
Sex Differences in the Association Between Regular Physical Activity and Incident Atrial Fibrillation: A Meta-analysis of 13 Prospective Studies

in the sex-stratified analysis:

13 studies involving physical activity and atrial fibrillation
Total number of participants: 568072
5 studies examined the association between physical activity and developing AF in man (n = 81027)
5 studies examined the same association in women (n = 131729)
10 studies evaluated the association between total physical activity exposure and the risk of AF
11 studies evaluated the association between intensive physical activity (vigorous, high intensity, or heavy workload) and the risk of AF.
The duration of follow-up varied from 5 to 15 years
Sex Differences in the Association Between Regular Physical Activity and Incident Atrial Fibrillation: A Meta-analysis of 13 Prospective Studies

<table>
<thead>
<tr>
<th>Geographic region</th>
<th>Total PA and AF</th>
<th>Intensive PA and AF</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pooled RR</td>
<td>95% CI</td>
</tr>
<tr>
<td>America</td>
<td>0.95</td>
<td>0.86-1.06</td>
</tr>
<tr>
<td>Non-America</td>
<td>1.05</td>
<td>0.86-1.27</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sex</th>
<th>Total PA and AF</th>
<th>Intensive PA and AF</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pooled RR</td>
<td>95% CI</td>
</tr>
<tr>
<td>$M^a$</td>
<td>1.18</td>
<td>1.02-1.37</td>
</tr>
<tr>
<td>$F$</td>
<td>0.92</td>
<td>0.87-0.97</td>
</tr>
</tbody>
</table>

Abbreviations: AF, atrial fibrillation; CI, confidence interval; F, female; M, male; PA, physical activity; RR, relative risk.

$^a$Total PA exposure was associated with an increased risk of AF in men, especially at age <50 years (RR: 1.58, 95% CI: 1.28-1.95, $P < 0.00001$).
Relation of Vigorous Exercise to Risk of Atrial Fibrillation

Logistic regression analyses stratified by time were used to assess the association between frequency of vigorous exercise and risk of developing AF in 16,921 apparently healthy men in the Physicians’ Health Study. During 12 years of follow-up, 1,661 men reported developing AF.

In subgroup analyses, this increased risk was observed only in men <50 years of age.

In conclusion, frequency of vigorous exercise was associated with an increased risk of developing AF in young men.
Conclusions: Among participants of a 90 km cross-country skiing event, a faster finishing time and a high number of completed races were associated with higher risk of arrhythmias. This was mainly driven by a higher incidence of AF and bradyarrhythmias. No association with SVT or VT/VF/CA was found.

In a Swedish study, repeated participation in the 90-kilometer cross-country ski race Vasaloppet was associated with increased risk of AF in men, but not in women.
Atrial fibrillation as risk factor for cardiovascular disease and death in women compared with men: systematic review and meta-analysis of cohort studies


RESULTS
30 studies with 4 371 714 participants were identified.

Atrial fibrillation was associated with a higher risk of all cause mortality in women (ratio of relative risks for women compared with men 1.12, 95% confidence interval 1.07 to 1.17) and a significantly stronger risk of stroke (1.99, 1.46 to 2.71), cardiovascular mortality (1.93, 1.44 to 2.60), cardiac events (1.55, 1.15 to 2.08), and heart failure (1.16, 1.07 to 1.27). Results were broadly consistent in sensitivity analyses.

CONCLUSION
Atrial fibrillation is a stronger risk factor for cardiovascular disease and death in women compared with men
Le donne hanno una maggiore incidenza di ictus e di mortalità rispetto agli uomini.
Le donne hanno un maggior rischio di sanguinamento dalla terapia anticoagulante di quanto non facciano gli uomini.
Le donne hanno un rischio più elevato di aritmie pericolose per la vita e le frequenze cardiache lente che richiedono stimolazione permanente quando vengono trattati con farmaci antiaritmici.
Le fluttuazioni ormonali durante il ciclo mestruale normale possono causare più aritmie potenzialmente fatali.
Le donne hanno un rischio maggiore di bassi livelli di potassio nel sangue, aumentando il rischio di aritmie legati alla droga.
Le donne hanno una maggiore sensibilità alle terapie di supporto come le statine e vasodilatatori.
Le donne con fibrillazione atriale hanno una minore qualità della vita.
Ricordate che la terapia ablativa è un'opzione per le donne sintomatiche a causa di percentuali di successo simili negli uomini.

Emdin CA et al. BMJ 2016;352:h7013
It should be considered that the abovementioned reports which shed light on safe levels of exercise intensity for both male and female patients living with AF could have some potential limitations.

- There was no strict definition of physical activity, which could have created confounding biases.
- Moreover, the duration of follow-up and the method of AF ascertainment were highly variable, and the subtypes of AF could not be identified.
- Also, one-time electrocardiographic screening for AF might miss a number of patients with asymptomatic paroxysmal AF.
Our purpose was to analyze atrial performance in female endurance athletes and compare it with males. We included 83 subjects; 39 women (19 athletes, 20 controls) and 43 men (22 athletes, 21 controls). Left (LA) and right atrial (RA) volumes and function were assessed using 2D-echocardiography and speckle-tracking strain: atrial strain-rate a-wave (SRa) and s-wave (SRs) as surrogate of atrial contractile function and reservoir function, respectively. Mean age was similar between groups (36.6 ± 5.6 years).

The atria of athletes shows a remodelling as compared to sedentary groups, with larger size and lower deformation at rest, particularly for the RA.

In men, remodelling is more pronounced with larger RA volumes and lower atrial deformation. The different atrial adaptation in both genders might be related to the different incidence of atrial fibrillation.
Gender Differences of Atrial and Ventricular Remodeling and Autonomic Tone in Nonelite Athletes
Wilhelm M Am J Cardiol 2011;108:1489-1495
Effect of Gender on Atrial Electrophysiologic Changes Induced by Rapid Atrial Pacing and Elevation of Atrial Pressure


Clinical Characteristics

<table>
<thead>
<tr>
<th></th>
<th>Premenopausal Women</th>
<th>Young Men</th>
<th>Postmenopausal Women</th>
<th>Elderly Men</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.</td>
<td>10</td>
<td>12</td>
<td>11</td>
<td>12</td>
</tr>
<tr>
<td>Age (years)</td>
<td>34 ± 10</td>
<td>36 ± 16</td>
<td>61 ± 8</td>
<td>60 ± 9</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>163 ± 14*</td>
<td>176 ± 16</td>
<td>160 ± 25*</td>
<td>177 ± 13</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>80 ± 30</td>
<td>83 ± 18</td>
<td>78 ± 23</td>
<td>82 ± 12</td>
</tr>
<tr>
<td>Body surface area (m²)</td>
<td>1.9 ± 0.3</td>
<td>2.0 ± 0.2</td>
<td>1.8 ± 0.2</td>
<td>2.0 ± 0.3</td>
</tr>
<tr>
<td>Left ventricular ejection fraction</td>
<td>0.61 ± 0.03</td>
<td>0.63 ± 0.04</td>
<td>0.62 ± 0.02</td>
<td>0.62 ± 0.03</td>
</tr>
<tr>
<td>Left atrial size (cm)</td>
<td>3.4 ± 0.4</td>
<td>3.6 ± 0.3</td>
<td>3.5 ± 0.5</td>
<td>3.7 ± 0.2</td>
</tr>
</tbody>
</table>

Variables are expressed as mean ± 1 SD.
*P < 0.05 vs age-matched men.

Atrial Effective Refractory Periods

<table>
<thead>
<tr>
<th></th>
<th>Premenopausal Women (n = 10)</th>
<th>Young Men (n = 12)</th>
<th>Postmenopausal Women (n = 11)</th>
<th>Elderly Men (n = 12)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sinus cycle length (msec)</td>
<td>859 ± 120</td>
<td>790 ± 150</td>
<td>890 ± 113</td>
<td>802 ± 124</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>Mean ERP (msec)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sinus rhythm</td>
<td>211 ± 19*†</td>
<td>246 ± 34**†</td>
<td>242 ± 17*†</td>
<td>240 ± 12*†</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Atrial pacing</td>
<td>169 ± 18*</td>
<td>171 ± 24*</td>
<td>172 ± 19*</td>
<td>173 ± 19*</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>AV pacing</td>
<td>163 ± 20</td>
<td>162 ± 26</td>
<td>151 ± 25</td>
<td>149 ± 28</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>Mean changes in ERP msec‡</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Atrial pacing</td>
<td>43 ± 8</td>
<td>74 ± 21*</td>
<td>70 ± 20*</td>
<td>68 ± 19*</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>AV pacing</td>
<td>48 ± 16</td>
<td>84 ± 26</td>
<td>91 ± 27</td>
<td>92 ± 30</td>
<td>&lt;0.05</td>
</tr>
</tbody>
</table>

Variables are expressed as mean ± 1 SD. ERP = effective refractory period.
*P < 0.05 vs AV pacing; †P < 0.05 vs atrial pacing.
‡Changes in pressure compared with sinus rhythm.
La fibrillazione atriale (FA) è una delle aritmie di più frequente riscontro nella popolazione generale, con un’incidenza di circa lo 0.1% all’anno ed una prevalenza media dello 0.95%. I valori di prevalenza variano a seconda dell’età e risultano molto bassi (0.1- 0.2%) al di sotto dei 55 anni, fascia di età in cui maggiormente si concentrano i soggetti che praticano attività sportiva. La FA può insorgere in cuori strutturalmente sani o nell’ambito di una cardiopatia. Può essere un sintomo di patologie insidiose come la miocardite, la cardiomiopatia aritmogenica del ventricolo destro, la cardiomiopatia dilatativa, la sindrome di Brugada, ecc., che pertanto vanno escluse.

L’idoneità ad un atleta con FA parossistica o persistente in assenza di cardiopatia può essere concessa quando è esclusa una cardiopatia sottostante, è stata individuata e rimossa un’eventuale causa scatenante, non vi è rapporto di causa-effetto tra attività sportiva ed aritmia, non è dimostrabile una malattia del nodo del seno né vie anomale, l’attacco aritmico non è molto frequente e non induce sintomi significativi e quando il soggetto non è in terapia anticoagulante.