




BMJ Open Cardiac arrhythmia assessment with patch electrocardiogram versus insertable cardiac monitor: a cohort study in endurance athletes with atrial fibrillation

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ABSTRACT

Objectives The objective of this study was to assess the quality of ECG recordings and the concordance between the automatic detection of cardiac arrhythmia episodes by a patch ECG and an insertable cardiac monitor.

Design Prospective cohort study.

Setting and participants Endurance athletes diagnosed with paroxysmal atrial fibrillation (AF) and no other relevant comorbidities participating in a randomised controlled trial on the effects of training adaptation.

Methods A patch ECG (ECG247 Smart Heart Sensor) was sent to 29 non-elite endurance athletes with clinical paroxysmal AF. ECG247 continuously monitors, detects and categorises cardiac arrhythmias. The participants were simultaneously monitored with an insertable cardiac monitor (Confirm Rx, Abbott). ECG recording quality was assessed by an experienced physician. Training sessions were monitored using sports watches.

Results Out of 29 invited athletes, 14 athletes (mean age 60.4 years, 2 women) made use of the patch ECG and were monitored for a total of 2987 hours and a median of 14 (range 1–17) days. During this period, the athletes performed a total of 112 training sessions. ECG quality varied between athletes and by type of exercise, with poor quality in 16% and 40% of recordings during cross-country skiing and running, respectively. In two athletes, the patch ECG detected AF episodes that were confirmed with insertable cardiac monitor recordings. One technical artefact was falsely classified as ventricular tachycardia by the ECG247 Smart Heart Sensor system.

Conclusion Monitoring with patch ECG was feasible in endurance athletes, but ECG recording quality varied between athletes and by type of exercise.

Trial registration [NCT04991337](https://www.clinicaltrials.gov/ct2/show/study/NCT04991337) (for the related randomised controlled trial).

INTRODUCTION

Prolonged and strenuous endurance exercise may promote cardiac arrhythmias.¹ In particular, studies have revealed a high prevalence

STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ The main strength of the study is the thorough monitoring of cardiac arrhythmias with both patch ECGs and insertable cardiac monitors.
- ⇒ More than 400 recordings during various types of endurance sports sessions were assessed.
- ⇒ The main limitation of this study is the relatively low number of included athletes.
- ⇒ As in most studies among athletes, females were under-represented.

of atrial fibrillation (AF) in middle-aged and older male endurance athletes.^{2,3} The prevalence of AF is lower in young athletes, but the relative risk of developing exercise-related AF may be higher in younger compared with older male athletes,⁴ and recent reports suggest that female athletes may also be at increased risk of AF.^{5,6} Moreover, other cardiac arrhythmias, such as atrial flutter and atrioventricular block, are relatively common among endurance athletes,^{7,8} and atrioventricular nodal re-entrant tachycardia is commonly seen in younger and otherwise healthy individuals.⁹ Malignant ventricular arrhythmias are less common but may be triggered by strenuous exercise, and the main goal of preparticipation evaluation programmes in athletic individuals is to prevent exercise-related sudden cardiac death.

For various reasons, sports physicians face an increasing number of athletes concerned about cardiac conditions. Participation in endurance sports is increasingly popular, and athletes may be more aware of exercise-related symptoms compared with less active individuals. Palpitations, describing subjectively

experienced irregular heartbeats, are the most common cause for referral to a cardiologist among athletes.¹⁰ Palpitations may be caused by a wide variety of aetiologies,¹¹ and the symptom intensity does not necessarily reflect the severity of the underlying pathophysiology. Although the cause is often benign, previous studies have reported cardiac aetiologies in around 40% of adult individuals presenting with palpitations.¹²

The initial evaluation should include a comprehensive history focusing on the characteristics of the symptoms, such as onset, termination, frequency, duration and triggers. A standard 12-lead ECG is recommended in all patients presenting with palpitations.¹¹ However, cardiac arrhythmias typically present with short and rare episodes in athletes, suggesting that standard or intermittent ECGs may have a low sensitivity to detect paroxysmal arrhythmias. Furthermore, prolonged ECG monitoring may be particularly challenging for individuals with a very active lifestyle. ECG recordings are prone to artefacts and detached electrodes caused by upper body movement and excessive perspiration during activity.

Prolonged monitoring with patch ECG may represent a promising alternative in athletes with infrequent palpitations or other cardiac symptoms and when rare arrhythmia episodes are suspected. Yet, the quality of ECG recordings obtained by this method in athletic individuals remains sparsely studied. The aim of this study was to investigate the quality of ECG recordings during exercise and the concordance between the automatic detection of significant arrhythmic episodes by the patch ECG and an insertable cardiac monitor in a cohort of highly active endurance athletes with symptomatic paroxysmal AF.

METHODS

Design and setting

This observational cohort study is a substudy of the randomised controlled trial (RCT) Effects of Detraining in Endurance Athletes with Atrial Fibrillation (NEXAF Detraining), ClinicalTrials.gov Registry Identifier NCT04991337, of which the main aim is to investigate whether training adaptation with reduced amounts and intensity of training could reduce AF burden in endurance athletes with clinical paroxysmal AF.¹³ This report is in concordance with the Strengthening the Reporting of Observational Studies in Epidemiology initiative checklist for cohort studies (online supplemental table 1). The participants in NEXAF Detraining are athletes aged ≥ 18 years, who are diagnosed with paroxysmal AF and have experienced at least two symptomatic episodes of AF, of which one was during the past 6 months. The study participants engage in regular endurance sports for ≥ 5 hours/week on average. Athletes with cardiovascular risk factors or relevant comorbidities are excluded from participating in the study. The eligibility criteria and further details have been published previously.¹³ The current substudy was not pre-specified in the published version of the RCT study protocol, but included in an updated version (V.4.8,

2 October 2023, online supplemental file). We took the opportunity to assess the quality of a patch ECG system among athletes who had already received an insertable cardiac monitor as part of the NEXAF Detraining trial. Up until 10 November 2023, 29 participants were enrolled in the study at Bærum Hospital, Bærum, Norway, or at St. Olavs Hospital, Trondheim, Norway, of whom all 29 were invited to participate in this substudy. The study size was determined by the funding of the patch ECGs. As of 27 November 2024, a total of 47 athletes have been included in the related RCT, and the recruitment is ongoing.

Cardiac arrhythmia monitoring

A patch ECG system consisting of a reusable single-lead monitor and two patches (ECG247 Smart Heart Sensor, Appsens, Lillesand, Norway, [figure 1](#)), an information letter and a user manual, was sent to the study participants by mail during the period 10 November to 23 December 2023. The information letter described the purpose of the substudy and requested the participants to use the patch ECG for at least 7 days. Using artificial intelligence algorithms, the patch ECG continuously monitors, detects and categorises cardiac arrhythmia episodes, which are transferred to a smartphone application with Bluetooth technology.¹⁴ The ECG recordings are accessed using the ECG247 web portal. The system provides periodic ECG recordings of 60 s with 30 min intervals, and recordings of detected cardiac arrhythmias classified as irregular beats, ventricular premature beats, supraventricular premature beats, AF and ventricular tachycardia (VT). The system also provides reports with total durations and proportions (duration divided by total time monitored) of cardiac arrhythmias (VT ≥ 30 s, VT < 30 s, supraventricular tachycardia (SVT) ≥ 30 s, SVT < 30 s, pauses > 4 s, heart rate (HR) < 30 beats per minute, AF, atrial flutter, HR ≥ 180 beats per minute (≥ 5 min) and ≥ 180 beats per minute (< 5 min)).

ECG recordings during exercise sessions (periodic recordings and recordings of detected arrhythmias) from each participating athlete were manually reviewed and the quality of ECG recordings was assessed and classified as good (interpretable and without technical artefacts), acceptable (interpretable as sinus rhythm or AF, but with technical artefacts) or poor (difficult or impossible to interpret) by an experienced physician and AF researcher (MM). Arrhythmia episodes were reviewed and assessed in consensus between experienced physicians and cardiologists (MM, TA, JML, JPL, AT, TB).

As part of the randomised controlled trial NEXAF Detraining, all participants had previously received an insertable cardiac monitor (Confirm Rx, Abbott, Sylmar, California, USA) for continuous monitoring of cardiac arrhythmias. This monitor is inserted subcutaneously near the left parasternal area on the participant's chest and was programmed to detect AF episodes lasting ≥ 30 s, pauses ≥ 3 s, bradycardia with HR ≤ 30 beats per minute and tachycardia lasting ≥ 12 beats with an HR ≥ 180 beats per minute, but not premature beats. The insertable cardiac monitor connects via Bluetooth to a smartphone

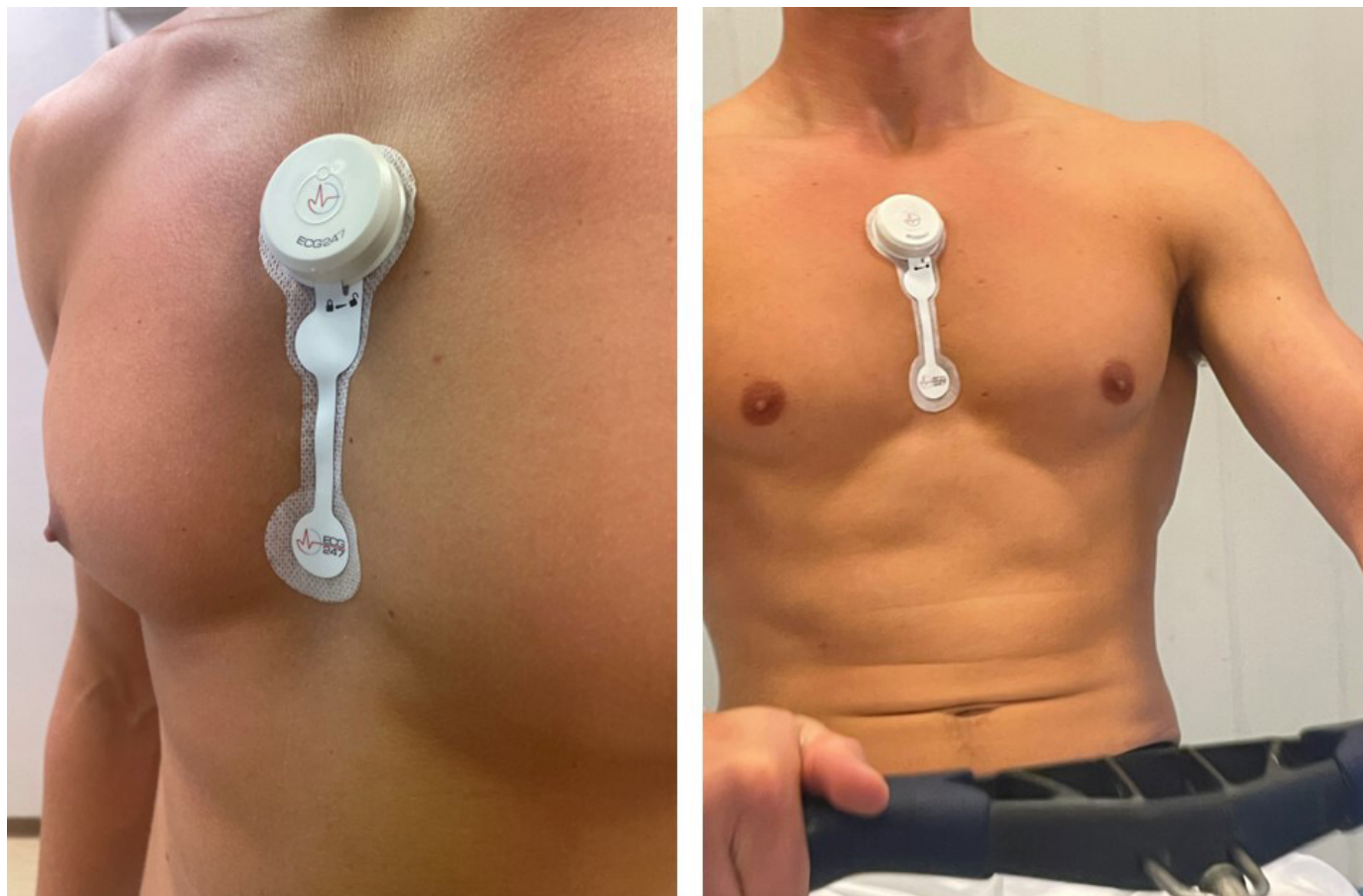


Figure 1 Pictures showing the use of the ECG247 Smart Heart Sensor patch ECG at rest and during rowing activity in a male endurance athlete.

application. Data are uploaded to a secure server, and summarised reports of arrhythmia episodes are available to the researchers on a web-based platform (Merlin.net Patient Care Network).

Other variables

Weekly hours of exercise were self-reported by questionnaires and body height and weight were measured during the baseline visit of the randomised controlled trial NEXAF Detraining.¹³ Body mass index was calculated as kg/m^2 .

Training monitoring

Participants in NEXAF Detraining were asked to record all training sessions during the study period using a heart rate monitor strapped around the chest (Garmin HRM Pro) with Bluetooth technology connection to a sports watch (Garmin Forerunner 745). Training sessions were automatically uploaded to a web-based platform (Fitrockr, Digital Rebels, Berlin, Germany).

Statistics

We report continuous variables as means with standard deviations (SD) or medians with range (minimum–maximum), and categorical variables as numbers and

percentages. The analyses were performed using Ledidi Core, Oslo, Norway, V.de7e4cc.

Patient and public involvement

Patients, a user organisation (the Norwegian Health Association) and individuals representing the public were involved in the design and development of standard operating procedures for the NEXAF Detraining trial. The study website (www.nexaf.no) is used to disseminate results from the study to participants.

RESULTS

Out of the 29 invited study participants who received a patch ECG by standard mail, 14 athletes (48%) made use of the patch ECG in the period between 19 November 2023 and 17 January 2024 and were included in this analysis. The remaining 15 did not respond to the invitation. Characteristics of the study participants are presented in [table 1](#).

The participants were non-elite competitive or recreational endurance athletes with clinical paroxysmal AF and no cardiovascular or other relevant comorbidities, performing an average of six weekly hours of exercise. Two women (out of two invited) participated. The participants

Table 1 Characteristics of study participants (n=14) continuously monitored with the ECG247 Smart Heart Sensor and an insertable cardiac monitor

Characteristics	Mean (median, range)
Age (years)	60.4 (60.5, 50–75)
Body height (cm)	181 (180, 166–198)
Body weight (kg)	76.6 (78.4, 57.4–95.1)
Body mass index (kg/m ²)	23.2 (24.2, 20.8–24.3)
Weekly hours of exercise	6.2 (5, 4–10)
	n (%)
Female	2 (14)
Primary sport	
Cycling	6 (43)
Cross-country skiing	5 (36)
Running	2 (14)
Other	1 (1)
Competitive athlete	11 (79)

used smartphones with either iOS or Android operating systems.

The athletes were monitored for a total of 2987 hours (124.5 days) with a median duration of the ECG247 test of 14 (range 1–17) days. All tests performed with the patch ECG were interpretable, but in two athletes who wore the patch ECG for 14 days, only 1 and 3 days, respectively,

were recorded due to technical problems that seemed to be related to the wireless transmission of ECG data to the smartphone application. During a total of 124.5 days with available ECG recordings, the athletes performed 112 (0.9 per day) exercise sessions (median 8, range 0–20) and a total of 124.5 hours of exercise (1 hour of exercise per day on average), including highly dynamic sports and sports that require strenuous upper body work, such as cross-country skiing (40 sessions), rowing (10), running (27), cycling (13), strength training (8) and other types of exercise (14).

We reviewed a total of 415 ECG recordings during 112 exercise sessions (median 13.5 ECG recordings per athlete). [Table 2](#) summarises the quality of ECG recordings per athlete. The quality of the ECG recordings varied by the type of exercise ([table 3](#)). While the vast majority (96%) of ECGs recorded during cycling, rowing, strength training and other types of exercise showed overall good or acceptable quality, 16% of recordings during cross-country skiing and 40% of recordings during running showed poor quality. Notably, 12 out of 19 of the poor-quality recordings during running were from the same female athlete, probably due to movement artefacts. Except for three sessions of running in this athlete and two sessions of cross-country skiing in another athlete, sessions with poor ECG recording also had recordings of good or acceptable quality. Examples of ECG recordings during exercise are shown in [figure 2](#). The patch ECG

Table 2 Quality of ECG247 Smart Heart Sensor ECG recordings during 415 exercise sessions per participating athlete (n=14)

Athlete	Sex	Training sessions (n)	ECG recordings (n)	ECG recording quality		
				Good (n)	Acceptable (n)	Poor (n)
1	M	11	74	34	36	4
2	M	1	4	3	1	0
3	M	15	70	27	40	3
4	M	8	29	17	10	2
5	M	5	11	10	1	0
6	M	10	12	4	3	5
7	M	20	92	12	58	21*
8	M	11	22	0	15	7†
9	F	2	10	1	9	0
10	M	20	75	39	34	2
11	F	8	15	0	3	12‡
12	M	0	0	–	–	–
13	M	0	0	–	–	–
14	M	1	1	0	0	1
Total		112	415	147	210	57
Mean		8.0	29.6	10.5	15.0	4.1

*All 21 recordings during cross-country skiing.

†All seven recordings during running.

‡All 12 recordings during running in a female athlete.

ECG, electrocardiogram recordings by the ECG247 Smart Heart Sensor; F, female; M, male.

Table 3 Quality of ECG247 Smart Heart Sensor ECG recordings during 415 exercise sessions by sports type (n=14)

Type of exercise	Total recordings	ECG recording quality assessment		
		Good n (%)	Acceptable n (%)	Poor n (%)
Cross-country skiing	195	44 (23)	119 (61)	32 (16)
Cycling	53	29 (55)	23 (43)	1 (2)
Running	48	12 (25)	17 (35)	19 (40)
Rowing	30	17 (57)	13 (43)	0 (0)
Strength training	37	18 (49)	17 (46)	2 (5)
Other	52	27 (52)	22 (42)	3 (6)
Total	415	147 (35)	211 (51)	57 (14)

ECG; electrocardiogram recordings by the ECG247 Smart Heart Sensor.

system or the insertable cardiac monitors did not detect any cardiac arrhythmias during the exercise sessions.

In two athletes, the patch ECG detected AF episodes (figure 3A and B) that were confirmed during review and that were also identified from the insertable cardiac monitor recordings. These AF episodes did not occur during exercise. In both cases, there was a discrepancy between the patch ECG and the insertable cardiac monitor system in terms of duration and number of AF episodes. In the first athlete, the ECG247 Smart Heart Sensor system reported seven episodes with a total duration of 18 min, while the insertable cardiac monitor reported three episodes with a total duration of 38 min during the same time period. In the second athlete, the ECG247 Smart Heart Sensor system reported 42 episodes with a total duration of 52 min, while the insertable cardiac monitor system reported 16 episodes with a total duration of almost 5 hours (298 min) during overlapping time periods. In the same athlete, also a sequence of sinus rhythm was falsely categorised as AF by the ECG247 Smart Heart Sensor system. Careful review of insertable cardiac monitor reports revealed that the recorded AF episodes represented one continuous AF episode in each of the two athletes suggesting that both the patch ECG and the insertable cardiac monitor incorrectly registered multiple AF episodes.

The patch ECG detected one episode of arrhythmia that was classified by ECG247 as VT with 36 complexes (figure 3C). This episode did not occur during exercise and was not recorded by the insertable cardiac monitor, and after careful review and consensus between three experienced physicians, the episode was considered to represent a technical artefact.

No other cardiac arrhythmia episodes were recorded by the ECG247 Smart Heart Sensor system or by the insertable cardiac monitor, and no arrhythmias were identified from the insertable cardiac monitor recordings that were not identified from the ECG247 recordings. The ECG247 Smart Heart Sensor system reported an average of 64.1 supraventricular and 93.5 ventricular premature beats per 24 hours (table 4).

DISCUSSION

This study assessed the quality of ECG recordings during prolonged monitoring with a patch ECG in highly active endurance athletes with clinical AF. During a total monitoring period of almost 3000 hours, the study participants performed various types of exercise, including highly dynamic sports and strenuous upper body work. Notably, the quality of the ECG recordings varied both between athletes and across types of exercise, with relatively high proportions of poor-quality recordings during cross-country skiing and running. Both sports are highly dynamic, and the poor quality could probably be attributed to technical artefacts caused by upper body movements. The vast majority of the ECG recordings during other sports, including cycling and rowing, showed good or acceptable quality. All rowing sessions and most cycling sessions were performed indoors, which may have facilitated less upper body movement and more optimal recording conditions. This study supports the results of a previous study that demonstrated the feasibility of the ECG247 Smart Heart Sensor during cycling.¹⁵

Clinical implications

The study demonstrated concordance between monitoring with the patch ECG and insertable cardiac monitors for detection of AF episodes. Palpitations and other symptoms suspicious of cardiac conditions are common reasons for athletes to seek counselling, representing a clinical challenge for cardiologists, sports physicians and general practitioners. Moreover, the diagnostic evaluation may be particularly challenging in athletes for several reasons. Cardiac arrhythmias in athletes often present with short and rare episodes, requiring prolonged monitoring. The monitoring itself is complicated by the active lifestyle of the athlete, which may reduce the quality of ECG recordings. In athletes practising water sports and athletes with excessive perspiration during exercise, the detachment of electrodes is a well-known challenge. Sports including vigorous upper body movements are likely to cause technical artefacts, as demonstrated in our study. ECG monitoring may be particularly challenging in

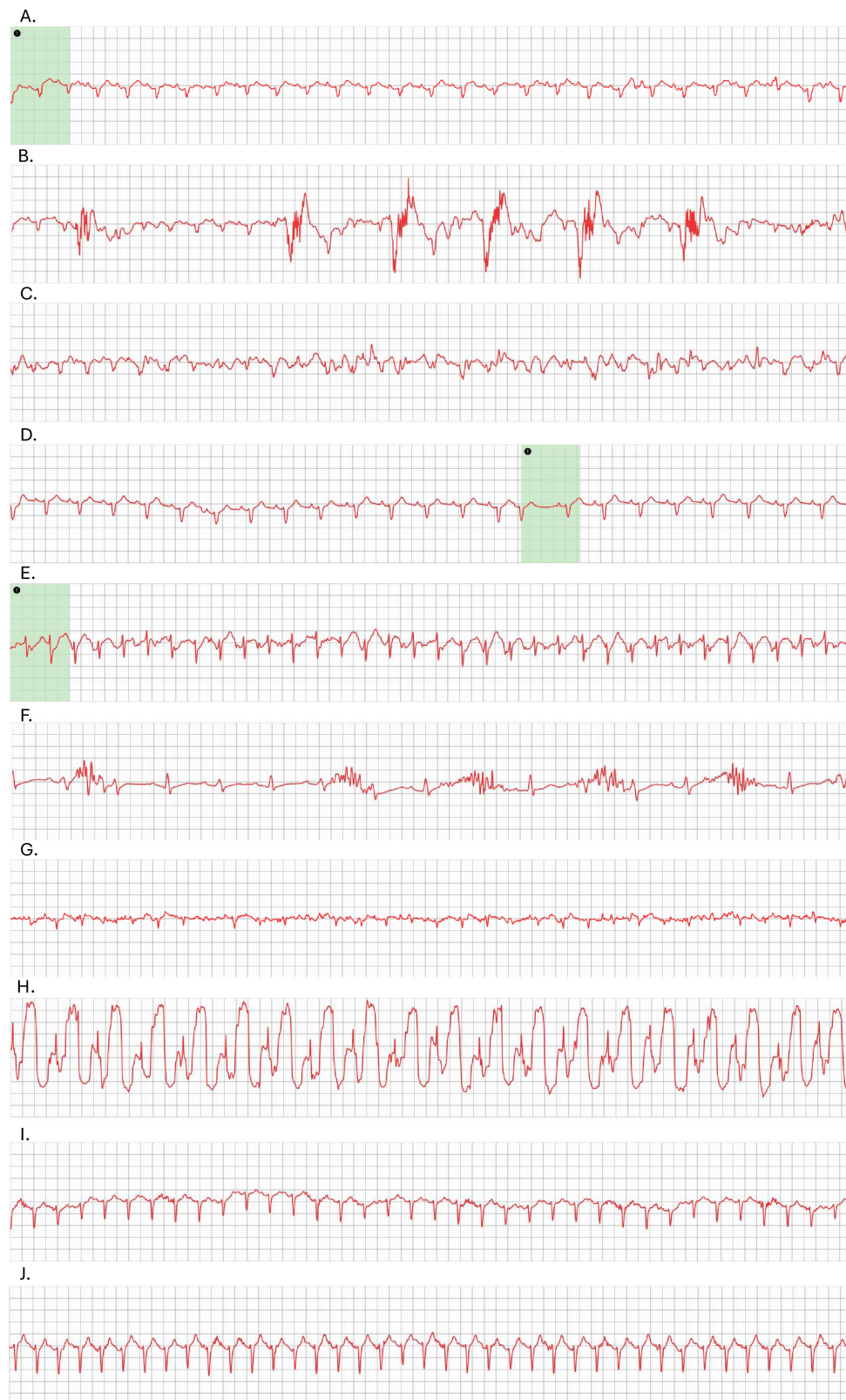


Figure 2 Recordings **A–C** from the ECG247 Smart Heart Sensor during the same session of cross-country skiing in an endurance athlete. During ECG quality assessment, the recordings were classified as good (A), acceptable (B) and poor (C). Recording (D) during a session of treadmill running in the same athlete showed good quality. **E** shows an ECG recording of poor quality during an outdoor running session in another athlete. Recording **F** shows typical regular upper body movement artefacts during cross-country skiing in a third athlete, with acceptable quality for identification of sinus rhythm. Recordings **G** and **H** during the same running session in a female athlete, showing technical artefacts, were classified as poor quality. Recordings **I** and **J** during sessions of rowing and strength training, respectively, in another athlete, were of good/acceptable quality. Recordings **E** and **F** 50 mm/s, all other recordings 25 mm/s. All interpretable ECGs show sinus rhythm.



Figure 3 Recordings of good quality of two atrial fibrillation episodes (**A** and **B**) from the ECG247 Smart Heart Sensor in two endurance athletes. Both episodes were confirmed by an insertable cardiac monitor. Recording categorised as ventricular tachycardia (**C**) by the ECG247 Smart Heart Sensor in an endurance athlete. The episode did not occur during exercise, was not detected by the insertable cardiac monitor and was after careful review considered to represent a technical artefact.

women due to anatomical differences and notably, 12 out of the 19 patch ECG recordings during running showing poor ECG quality were from the same female athlete. The low number of female athletes in the study prevents firm conclusions about the feasibility of using patch ECG during exercise in women, and future studies should address the impact of sex differences on the effectiveness of cardiac arrhythmia monitoring in athletes. Meanwhile, adjustment of the positioning of the ECG patch to a more proximal position above the sports bra may reduce artefacts in female athletes.

Identification of subclinical cardiac conditions associated with sudden cardiac death is the primary scope of preparticipation evaluation protocols.^{16 17} The use of

ECG as a supplement to personal history and physical examination is debated, and prolonged ECG monitoring is suggested only as a second-line test to explore unexplained syncope or bradyarrhythmias, and in patients with suspected Long QT syndrome.¹⁶ The current study was not powered to detect subclinical ventricular arrhythmias, and the value of prolonged ECG recordings to detect subclinical cardiac conditions and to prevent sudden cardiac death in athletes needs to be addressed in larger prospective studies. Prolonged ECG monitoring may also be used for the quantification of premature ventricular beats. In a recently published analysis in 281 elite athletes from the Pro@Heart study, Claessen and colleagues reported that premature ventricular beats were associated with reduced ventricular ejection fraction, a feature occurring in 15.7% of the studied athletes.¹⁸ The clinical relevance of this finding, however, is unknown.

The risk of false positive results is a major problem of preparticipation screening programmes.¹⁶ As demonstrated in our study, prolonged monitoring produces a large amount of ECG recordings requiring qualified assessment. The main scope of sports cardiology is to decipher signs of pathological remodelling associated with an increased risk of sudden cardiac death from physiological exercise-induced remodelling. ECG interpretation in athletes requires special skills, and as in one of the athletes in our study, even a technical artefact may imitate a malignant arrhythmia.

Table 4 Irregular beats, supraventricular and ventricular premature beats per 24 hours reported by the ECG247 Smart Heart Sensor system in endurance athletes (n=14)

	Beats per 24 hours		
	(mean)	Min	Max
Irregular beats	26.1	4	76
Supraventricular premature beats	64.1	13	173
Ventricular premature beats	93.5	3	641*

*Four athletes presented with >100 premature beats/24 hours.

While preparticipation evaluation is primarily integrated into professional or non-professional competitive sports, the role of screening programmes in recreational and veteran athletes remains less clear.¹⁹ In middle-aged and older athletes, AF is the most common clinically relevant cardiac condition, representing an additional rationale for screening.²⁰ Due to the often short and rare episodes, both standard ECG at rest and intermittent ECG recording have limited sensitivity to detect AF, and the arrhythmia remains undetected in some individuals. Similar to the general population, athletes with AF who also have concomitant cardiovascular risk factors and/or age above 65 years seem to be at increased risk of stroke.^{3,21} Prolonged continuous ECG monitoring for the purpose of AF screening may be an attractive option, particularly in individuals where the diagnosis of AF would lead to treatment with anticoagulation, and in symptomatic individuals where a definite diagnosis may be necessary to offer ablation or drug therapy. Prolonged monitoring may also be considered to quantify the burden of premature atrial beats. AF episodes were detected with acceptable ECG quality and confirmed by an insertable cardiac monitor in this study. It is reassuring that no episodes were identified from the insertable cardiac monitors that were not also identified by the ECG247 monitor. Still, the sensitivity and specificity of patch ECG to detect AF in athletes should be studied further. While associated with an increased risk of AF in general populations, the relevance of premature atrial contractions as a predictor for atrial fibrillation in athletes is not known.²²

Limitations

The low number of participants may limit the interpretation of the AF detection rate by patch ECG as compared with insertable cardiac monitors. Still, as for the patch ECG recordings during strenuous physical activity, most recordings showed acceptable quality and were interpretable. The study was underpowered to detect subclinical cardiac arrhythmias. From a screening and environmental perspective, the rate of 48% who made use of the monitor and patches sent was low. An explanation may be that the invited athletes were already diagnosed with AF and under continuous monitoring with an insertable cardiac monitor, which may have reduced their perceived value of additional monitoring with a patch ECG. Some of the athletes experienced technical issues. A limitation of the study is that the reasons for the lack of response in more than half of the athletes were not assessed. Previous studies have revealed highly variable acceptability of device monitoring of cardiac arrhythmias with equally high dropout rates.²³ Technical issues, low motivation, perceived low utility and value are well-known barriers to healthy technology. A high-quality user manual and user support may prevent technical problems. As an example, users should be informed that a low battery or the use of low power mode on the connected smartphone may reduce the functionality of the application. As for most studies among athletes, females were under-represented.

While sudden cardiac death is much less common in female compared with male athletes, female athletes may also be at increased risk of AF.^{4,5}

CONCLUSIONS

In conclusion, a patch ECG system with prolonged continuous arrhythmia monitoring is feasible for use among highly active endurance athletes. The patch ECG system provides acceptable quality ECG recordings in various types of exercise, but the quality is diminished in sports that involve strenuous upper body work. Further studies are needed to address the sensitivity and specificity of patch ECG in detecting cardiac arrhythmias in athletes.

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Contributors MM and TB designed the current substudy and drafted the manuscript. TA, ABS, JML, SO, SE and MM participated in the enrolment of the study participants and conducted the procedures of the study. TA, JML, JPL, AT, TB and MM review the ECGs. TA, AT, GC, ALG, JPL and MM designed the related randomised controlled trial. TA, ABS, JML, SO, SE, AT, BD, GC, ALG, JPL, TB and MM read and contributed to the manuscript, gave approval and agreed to be accountable for all aspects of the work. MM is responsible for the overall content as the guarantor.

Competing interests None declared.

Patient and public involvement Patients and/or the public were involved in the design, or conduct, or reporting, or dissemination plans of this research. Refer to the Methods section for further details.

Patient consent for publication Not applicable.

Ethics approval This study involves human participants. The study was approved by the regional committee for Health Research Ethics (Ethics committee reference number: REK sør-øst A/212748). Participants gave informed consent to participate in the study before taking part.

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