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The Ladies' Trophy and the flip side of the medal

IN BYGONE DAYS

MARIUS MYRSTAD

marium@vestreviken.no
Marius Myrstad, senior consultant and researcher at Bærum Hospital and head of the Norwegian Exercise and Atrial Fibrillation Initiative (NEXAF).
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The history of athlete's heart in Norway begins in the late 19th century when researchers started measuring skiers' pulse and heart size. But who was the first cross-country skier with atrial fibrillation?

Johan Evjen (1887–1971) with his trophy collection, around 1935. Photo: Karl August Berg/Orkla Industrial Museum. In public ownership.

Athlete's heart is characterised by symmetrical hypertrophy of the atria and ventricles, increased capacity during physical exercise and electrical remodelling (1). It is most common in endurance athletes, such as cross-country skiers. The phenomenon is considered a result of benign physiological adaptation to increased hemodynamic load during physical exercise. However, studies have shown a preponderance of atrial fibrillation among male cross-country skiers (2).

Athlete's heart

In the 19th century, skiing competitions gradually became more commonplace in Norway, and the Association for the Promotion of Skiing held their first race in 1883. As from 1892, the venue was Holmenkollen in Oslo, where there was both ski jumping and cross-country skiing. Prizes were awarded to the best skiers in various classes, but the Ladies' Trophy was given to 'the most dashing skier from Kristiania' (3). The first 50-kilometre race was held in 1888. Although the purpose of the long-distance race was 'to encourage the youth to engage in sensible training and gain a better understanding of the benefits of skiing', medical examinations were carried out both before and after the races as a precaution. An 'irregular pulse' was observed in several of the participants at the finish line. However, 'in the rush, there was no time to examine the nature of the irregularity more closely'. Descriptions of some participants leave no doubt that the 50-kilometre race was an extreme physical challenge: 'Facial colour tends to be decidedly pale, sometimes a grey pallor, in other cases there is concurrent cyanosis (...) The pulse is rapid, weak and soft, sometimes imperceptible and irregular' (4).

Despite the interest in the skiers' pulses, it was the size of their heart that attracted particular attention. Palpation of the apex of the heart and cardiac percussion revealed that some participants had unusually large hearts (4). This led to the term *athlete's heart* being coined. Around the same time, a Swedish professor conducted similar investigations and even claimed that the fastest skiers had the largest hearts (5). While some argued that athlete's heart was benign and resulted from physiological adaptations to physical exercise, others were quick to link both symptoms and examination findings to excessive training. In 1902, several newspapers published a critical article written by Dr Cato Aall:

'We doctors know that long-distance skiing is not healthy. We know that it costs many young people their health and well-being in later life. It is not without reason that the term 'athlete's heart' has been incorporated into our native medical language: it is especially found among young people who have overexerted themselves early on, for example in skiing, and who now have to suffer the consequences in the form of heart murmurs, feelings of anxiety, shortness of breath, etc., symptoms that stem from what I might call a 'misused' heart. And these conditions must be prevented.' (6)

The medical history of a racer is described in an article published in a Norwegian medical journal (*Norsk Magazin for Lægevidenskapen*) in 1915 (7):

'About 3 weeks ago, he suddenly experienced shortness of breath, which has reoccurred frequently over the past 14 days... Two doctors from Kristiania who examined him stated that he had developed athlete's heart through excessive physical exercise, and advised him to refrain from all physical activity for about a year. Upon examination, I was able to observe the following deviations from the norm: heartbeat in the 6th intercostal space. About 1.5 cm lateral to the mammillary line. Pulse: irregular.'

In the decades that followed, systematic heart examinations were performed on athletes in Norway, and it became increasingly common to advise against participation in competitive sports. Between 1920 and 1939, a total of 77,826 medical examinations were carried out on athletes in the Norwegian Sports Federation, across 129 medical practices. Around 500 people were advised against participating in sports, while approximately 2600 were told to avoid physical exercise 'for the time being', and more than 2500 were urged to exercise with caution (8). At the first Birkebeiner (cross-country skiing) race in 1932, all athletes were required to undergo a medical examination before the start. Some skiers were prohibited from starting due to, for example, respiratory infections and abnormal pulse. During the Holmenkollen races in 1935, the heart size of 110 participants in the 50 km and 17 km cross-country races was examined using X-ray. One participant had an abnormally enlarged heart before the start, but follow-up examinations showed no sign of heart disease (8).

The first cross-country skier with atrial fibrillation

An article from 1927 contains what is likely the first documented case of atrial fibrillation in a cross-country skier (9). The patient was 44 years old and was hospitalised in 1925 due to poor physical condition and reduced circulation in the lower extremities. He had previously been an active skier and, as a young man, had participated in the Holmenkollen races. The author of the article, Nils Backer Grøndahl, even claimed that the patient had been awarded the Ladies' Trophy. The patient had also 'been skiing regularly in recent years (...) However, during these physical activities, he has occasionally felt unwell (...), becoming short of breath to the point where he felt compelled to lie on the ground, experiencing pressure in his chest and a very irregular pulse. He also became short of breath during ski trips.'

At the time of admission to hospital, he had 'complete atrial fibrillation' and was diagnosed with an elongated embolus in the aorta and both femoral arteries.

Knowledge of heart rhythm disturbances was still relatively new at that time. In 1906, Dutchman Willem Einthoven had constructed the precursor to the electrocardiogram. At a conference in Bergen in 1911, Dr Rubow from Copenhagen gave a talk in which he described *arrhythmia perpetua*: 'It can be characterised as a continuous arrhythmia, where no regular periodic change can be observed, and in which, as a rule, no atrial contraction can be detected' (10). Rubow referenced Cushny and Edmunds, who in 1907 had published an early description of atrial fibrillation (11), as well as electrocardiographic research in Germany that supported the view that this was not a complete asystole of the atria, but rather 'atrial fibrillation'. In an article from 1914, the term *fibrillary arrhythmia* is used for the first time (12). Meanwhile, a 1924 newspaper article notes that Dr Nils B. Koppang had been using electrocardiography at his medical practice in Kristiania for nine years, since

1915 (13). At Bærum Hospital in 1926, they still did not have access to electrocardiography and 'no possibility of taking pulse curves of our patients, as our small medical staff has been occupied with other work' (14).

> *«The entire case is a dreadful example of how older people should not engage in sports»*

The aforementioned patient died after a prolonged illness, and an autopsy revealed that his heart was 'as big as two fists'. The author of the article, Backer Grøndahl, argued that the heart enlargement was consistent with athlete's heart and was caused by the patient continuing to overexert himself 'beyond the age of 40 (...) The entire case is a dreadful example of how older people should not engage in sports. (...) His heart condition is worth noting because the ageing athlete's heart has received little attention in Norwegian medicine, and we are in a time when many of the men who helped elevate the sport of skiing – and other sports – to prominence at the turn of the last century are now elderly, yet still not entirely unwilling to compete' (9)

Birkebeiner skiers with atrial fibrillation

Long-distance cross-country competitions became more common in the 1930s, and more and more men participated in ski races even after the age of 40. Johan Evjen, from the region of Trøndelag in Norway, was probably the first renowned skier with atrial fibrillation (15). When Evjen took part in the very first Birkebeiner race in 1932, he was 45 years old. Evjen and his contemporaries were often referred to as 'the old guys', and several of them were said to have been troubled by heart rhythm disturbances. However, it would take several decades before the connection between physical exercise and atrial fibrillation was more thoroughly explored (16).

> *«Older Birkebeiner participants have enlarged atria in their hearts, likely due to prolonged training, but their heart function remains well-preserved»*

At the start of the 2000s, Harald Arnesen and Jostein Grimsmo initiated follow-up studies of 78 older former Birkebeiner participants, and they found a strikingly high prevalence of atrial fibrillation (17). The Birkebeiner studies have subsequently expanded our understanding of skiers' heart health. Middle-aged and older male cross-country skiers have a longer lifespan and significantly lower prevalence of cardiovascular risk factors, yet the prevalence of atrial fibrillation is at least as high as that of others in the same age group (2, 18, 19). The risk of atrial fibrillation increases with the number of years spent doing regular endurance training (20). There are fewer studies on female athletes, but they appear to have a lower prevalence of exercise-related atrial fibrillation than men (21). Older Birkebeiner participants have enlarged atria in their hearts, likely due to prolonged training, but their heart function remains well-preserved (22).

Backer Grøndahl's patient and Johan Evjen lived in a different era, and both may have had other risk factors for atrial fibrillation besides physical exercise. While most skiers in the 1920s and 1930s had short careers, these two continued with endurance sports longer than was typical (23). Today's cross-country skiers train extensively, and many continue to compete well into their 50s. Whether atrial fibrillation is more common among athletes today than it was 100 years ago is unknown. The media often use terms like *heart fibrillation* or *atrial fibrillation* to describe cases of arrhythmia in athletes. In many cases, however, it is likely to be other supraventricular tachycardias, which occur relatively frequently among young adults. Whether these types of arrhythmias are more common in athletes than in others is still unknown.

> ***«Sports cardiologists still grapple with many of the same questions that doctors faced 100 years ago»***

Advancements in imaging diagnostics and increased research activity have expanded our understanding of athlete's heart, yet sports cardiologists still grapple with many of the same questions that doctors faced 100 years ago: To what extent does athlete's heart represent a higher risk for disease? How can we distinguish between pathological and physiological changes? As regards exercise-related atrial fibrillation, only some of the underlying mechanisms have been identified. We still lack knowledge on how cross-country skiers and other athletes with atrial fibrillation should approach physical exercise and competitive sports (24).

Backer Grøndahl's patient took part in the Holmenkollen races in 1904 and 1905, but the claim that he was awarded the Ladies' Trophy seems to have been an exaggeration (4). Instead, he experienced the 'flip side of the medal' and was perhaps the very first cross-country skier with atrial fibrillation.

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