Headache can have an impact on sport or physical activity, either coincidentally or as a direct result of participation. David Kernick outlines the mechanisms thought to cause headache during activity, and provides treatment advice, noting that some headache medications are restricted for professional sportsmen.

**EPIDEMIOLOGY OF SPORT- AND EXERCISE-INDUCED HEADACHES**

Estimates of the population prevalence of exertional headache range between 12% and 30%. It is particularly prevalent among adolescents, who are often the focus of exercise initiatives. From the perspective of sports activity, a study of university students found that 35% experienced sports-related headaches and a study of a large group of sports cyclists resulted in a rate of 26%. Sports-related headaches are likely to be more common in headache-prone individuals who experience other types of primary headache.

Four categories of sport-related headache are defined that provide a pragmatic organisation for practitioners (Box 1).

A recognised primary headache syndrome coincidental to sporting activity

**Tension-type headache**

Tension-type headache is the most common headache in the population. The headache is dull, occipital and bilateral. However, it is usually improved by exercise, alleviated by simple analgesia and unlikely to be a problem in sport.

**Migraine**

Although regular exercise can help reduce the frequency, intensity and duration of migraine attacks, it is likely to be the most
A recognised primary headache syndrome coincidental to sporting activity:
- tension-type headache
- migraine
- cluster headache

A recognised headache syndrome (migraine, tension-type headache) induced by sporting activity

Headache arising from mechanisms that occur during exertion:
- headache related to changes in cardiovascular parameters:
  - (i) headache associated with increased cardiac output
  - (ii) headache as a result of raised venous pressure
- headache related to trauma
- headache arising from structures in the neck

Headache arising from mechanisms that are individual to a specific sport

Common coincidental primary headache during sport.

For the acute attack, triptans (serotonin 5-HT_{1B/1D} receptor agonists) are the mainstay of treatment. However, apart from the potential impact of triptans on performance, particularly from a cognitive perspective, there are theoretical concerns regarding the potential for coronary vasoconstriction. For the amateur sportsman, a non-steroidal anti-inflammatory with a prokinetic or anti-emetic would be the first choice. If triptans are necessary during sport in amateurs or in elite sportsmen, underlying cardiac pathology, in particular ischaemic heart disease and cardiomyopathy, should be excluded with an exercise ECG and echocardiogram. Triptan formulations such as melts that are rapidly dissolved are not faster acting but may be more convenient in the sporting context.

Beta-blockers are a first choice in the preventive treatment of migraine in routine practice. The use of beta-blockers in many sports has obvious implications for limitation of performance and is banned in many professional sports. Topiramate (licensed), sodium valproate (unlicensed) or pizotifen (licensed) are reasonable alternative choices with appropriate monitoring for potential side-effects.

Cluster headache
Cluster headache has a very high impact but is rare. Sporting activity will be unlikely during the cluster period.

A recognised headache syndrome induced by sporting activity
Over 20% of migraineurs experience migraine precipitated by physical activity. It has been suggested exercise-induced migraine can be prevented by aerobic warm-up prior to activity, but the evidence base is poor. Tension-type headache does not restrict activities significantly. If an elite athlete has consistent exercise-induced headache, it may be best to start a preventive treatment as outlined above. There is no evidence that exercise-induced headache is induced by activity.

Headache arising from mechanisms that occur during exertion
The physiological processes that occur during sport can induce headache. If no underlying structural cause can be identified, these headaches are termed primary, even though pain-inducing mechanisms may be inferred. If there is a structural abnormality, the headache is termed secondary.

Headache related to changes in cardiovascular parameters: (i) associated with increased cardiac output
Although mechanisms are unknown, arterial or venous distension may be implicated.

Retrograde venous flow due to internal jugular vein incompetence has been suggested as one possibility. Having excluded a secondary cause, the treatment of primary exercise-induced headache is anecdotal. Gradual warm-up exercise programmes have been advocated, but for short-term prevention indomethacin is the treatment of choice. For more frequent occurrence, a beta-blocker is the drug most recommended providing there is no contraindication for the elite athlete.

Headache related to changes in cardiovascular parameters: (ii) caused by raised venous pressure
This headache is more common in sports such as weight-lifting and presumably caused by distension of the cerebral venous system. Intracranial hypotension is a rarer possibility but has been described. An important secondary cause is an Arnold-Chiari malformation, which must be excluded with magnetic resonance imaging (MRI).

Headache related to trauma
Headache is the most common symptom of a concussive injury, and post-traumatic headache accounts for 4% of all symptomatic headaches. Head injury involves shearing as a result of linear acceleration/deceleration or rotational forces. The degree of injury does not always correlate with headache symptoms and the mechanisms that generate pain are poorly understood. Headache may be due to direct stress acting on dural structures or secondary mechanisms as a result of bleeding or axonal damage.

The headache can occur immediately or within the first week following an injury. In many cases athletes may be unaware of the initial head injury. Later-onset headaches have been described but their causality is contested. Most cases resolve in the first 3 months following an injury.

Chronic post-traumatic headache is a headache that persists for 3 months after head trauma in the absence of a demonstrable traumatic brain lesion and
may be caused by maladaptive central sensitisation. It is invariably associated with a number of other symptoms such as dizziness, difficulties in concentration or insomnia, which form a post-traumatic syndrome. The relationship between the severity of the injury and severity of the post-traumatic syndrome is not always direct.

There is no evidence base to inform the treatment of traumatic headache. The first line of treatment is symptomatic and medication-overuse headache is always a cause for concern if analgesia is taken on more than 3 days in each week over the longer term. Amitriptyline can be effective. Developing secondary causes such as intracerebral or subdural haemorrhage and more rarely vertebral artery dissection should not be overlooked.

Headache arising from structures in the neck
Trauma to the neck can induce or exacerbate a cervical lesion, with subsequent referred pain to the head via the upper cervical nerves. From a practical perspective, if the patient is able to demonstrate full movement of the neck with no local tenderness, cervicogenic headache can be excluded.

Headache arising from mechanisms that are individual to a specific sport
A number of headaches unique to a sport have been described that have a specific aetiology. For example, headache in spinning figure skaters is thought to be a result of a centrifugal effect causing intracranial ischaemia. High-altitude headache is recognised as an accompaniment of acute mountain sickness and is thought to be due to a vascular phenomenon. Diving headache occurs as a result of CO₂ intoxication.

INVESTIGATION OF SPORT-RELATED HEADACHES
All exercise-induced headaches should be investigated with an MRI of the brain, blood pressure and ECG, blood screening for renal and liver function, haematology, thyroid disease and diabetes. Urinary catecholamines should be considered. This can be relaxed for stable migraine associated with exercise, providing examination is normal, particularly in headache-prone individuals.

Arnold-Chiari malformations and neoplasms are the most common secondary pathology. Subarachnoid haemorrhage and arterial dissection are the most common causes of acute presentations. Rarely, headache can be a direct and isolated symptom of cardiac ischaemia but the mechanism is unknown.

HEADACHE MEDICATION IN ELITE SPORTSMEN
There is the possibility that performance-enhancing drugs can induce headaches, and this should always be considered.

The Global Drug Reference Online (www.globaldro.com) provides athletes and support personnel with information about the prohibited status of specific substances based on the current World Anti-Doping Agency (WADA) prohibited list, and is relevant for those wishing to use prescribed and non-prescribed medication for their headache. If the medication an athlete is required to take to treat an illness or condition happens to fall under the prohibited list, a therapeutic use exemption may give that athlete the authorisation to take the needed medicine. This will depend on the sport and country where it takes place. Further details are available from WADA (www.wada-ama.org).

CONCLUSION
There are a number of problems with the study of headache in sport: the evidence base is very limited and studies are retrospective, leading to recall bias; formal diagnostic criteria are rarely used; the pathogenesis of the majority of headaches is poorly understood and different types of activity may lead to different pathophysiological mechanisms. The impact of headache on sport is also likely to reflect the perspective of headache sufferers in the community, ie stigmatised, largely unrecognised and inadequately managed, with the needs of many sufferers unmet. An important first step is an awareness of the problem by the GP, sports physician and those involved in sport and the encouragement of activity in the population at all levels.

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REFERENCES