

INDUSTRIAL INJURIES ADVISORY COUNCIL

Professor **A J NEWMAN TAYLOR**, CBE, FRCP, FFOM, FMedSci (Chairman)

Professor **M A AYLWARD**, CB, MD, FRCP, FFPM, FFOM, DDAM

Dr **M G BRITTON**, MD, MSc, FRCP, Dip (Ind. Health)

Dr **A COCKCROFT**, MD, FRCP, FFOM, MB, BS

Mrs **D KLOSS**, LLB, LLM

Dr **I J LAWSON**, MB, BS, DRCOG, MIOSH, FFOM

Mr **S LEVENE**, MA

Dr **K PALMER**, MA, DM, FFOM, MRCP

Mr **J PRESTON-HOOD**, MBA, DipHS, MIOSH, RSP

Mr **H ROBERTSON**, MSc, DipFMS, MIOSH, RSP

Dr **A SPURGEON**, BSc, PhD, C. Psychol

Ms **C SULLIVAN**, MA, GradDipPhys, MCSF

Mr **A TURNER**, TechSP

Mr **F M WHITTY** BA

Dr **L WRIGHT**, BMedSci, BMBS, FFOM

Previous Council members:

Dr **I BROWN**, BSc (Agric), FRCP, FFOM, DDAM

Mr **G IFILL**, BSc

Ms **J THURSTON**, BA

Mr **M PLATT**, BA, MSc

POSITION PAPER 15

Sporting Injuries

Dementia in boxers, footballers and jockeys; osteoarthritis of the knee and hip in footballers

SUMMARY

1. This review concerns the risk of dementia and head injuries in footballers, boxers, and jockeys and the risk of osteoarthritis of the hip and knee in association footballers. It has been undertaken in response to requests received by the Industrial Injuries Advisory Council (IIAC) to consider the terms of prescription in relation to these occupations and outcomes.
2. There is also current interest in whether footballers are at an increased risk of a rare neurological disorder, motor neurone disease. This was added to the field of inquiry.
3. Both 'accident' and 'prescription of disease' routes to benefit were investigated and expert written and oral evidence obtained. In addition, the Council's research librarian undertook targeted reviews of the literature. The evidence in its entirety was examined by members of the Council's Research Working Group.
4. It was concluded that there is currently insufficient evidence to recommend prescription of dementia in boxers or footballers.
5. For osteoarthritis of the hip and knee the Council found clear evidence that traumatic joint injury (e.g. fracture or torn cartilage) increases the later risk of osteoarthritis. Where osteoarthritis of the hip or knee follows an identifiable accident a claim for benefit may be considered under the accident provisions of the Industrial Injuries Disablement Benefit scheme. By contrast, the evidence that osteoarthritis of the hip or knee in footballers can arise in the absence of identifiable accidental injury is weaker and the Council does not feel able to recommend prescription in these circumstances.
6. No research was found on dementia following head injury in jockeys, while findings on motor neurone disease in footballers were inconsistent. In neither circumstance is prescription warranted.

BACKGROUND TO THE INVESTIGATION

7. In February 2003 an IAC member first brought to the attention of the Council a research article suggesting an increased risk of osteoarthritis of the hip in professional footballers. Subsequently a literature search was carried out on this topic. A letter was then received from the Professional Footballers' Association about a possible link between heading footballs and dementia and in May 2003 the Council placed sporting injuries on its programme of work.
8. A preliminary search suggested that there was adequate literature to form the basis of a review of dementia in boxers and perhaps footballers and substantial material on osteoarthritis of the hip and knee in sports in general, including association football. Following experts' comments, injuries in jockeys and the neurological disorder motor neurone disease (in which there is a topical interest in respect of footballers) were added to the field of enquiry.

Issues considered in the investigation

9. There are two routes to benefit under the Industrial Injuries Disablement Benefit (IIDB) scheme – accidental injury (accounting for 80% of awards) and prescription. An accident, for the purposes of IIDB, has been described in case law as any untoward event that arises out of and in the course of an employed earner's employment. These provisions cover not only the immediate and short-term disabling effects of an accident or a series of discrete, identifiable accidents but also long term effects and effects that may not occur until some time after the accident.
10. An accident may be accepted for compensation even if caused by negligence or foolhardiness on the part of the injured person, provided that it was not intended by that person. Similarly, accidents may be accepted for the purposes of the scheme in occupations that carry special risks of injury and where injuries occur more often than usual owing to the nature of the work.
11. A disease may be prescribed if there is a recognised risk to workers in a particular occupation and the link between the disease and the occupation can be established or reasonably presumed in individual cases. In investigating the possibility of prescription the Council must take into account several factors. The disease must be capable of being precisely defined. Also, scientific evidence must support the attribution of the disease to occupation in the prescribed circumstances and in the individual case. This may be on the basis of clinical features that indicate a uniquely occupational cause, or because epidemiological evidence exists to show that the risk of disease is increased by a factor of two or more in comparison with other occupations (Appendix 1 describes the rationale in further detail). Finally, the relevant exposure, including an appropriate level and duration, need to be defined in a way that can be practically confirmed under the scheme.
12. At present the list of prescribed diseases does not include any in relation to sporting occupations.

Method of investigation

13. Expert evidence was obtained from the parties listed in Appendix 2. There was no formal advertised call for evidence. But additionally, the Council's research librarian undertook several targeted reviews of the literature. The evidence in its entirety was examined by the members of the Council's Research Working Group.

Dementia

14. **Dementia** is a clinical syndrome characterised by loss of acquired intellectual function. Alzheimer's disease and diffuse vascular disease are the most common forms; other causes include malignant tumours, fronto-temporal dementia, hydrocephalus, toxins, infection and prion disease. Diagnosis is based on clinical features rather than tests; the aim of brain imaging being to identify any treatable causes rather than to confirm the condition. Dementia is predominantly a disorder of the elderly, which means that its clinical onset usually postdates retirement and is removed in time from any potentially relevant occupational exposures. This poses a challenge in making occupational attribution.

The evidence on dementia and boxing

15. The most obvious link between boxing and brain injury is the rare but catastrophic acute blow usually associated with cerebral haemorrhage. A literature search failed to identify any studies of the long-term sequelae of sub-lethal blows in boxers.
16. The second possible link between dementia and a career in boxing is that those who sustain repeated blows to the head may possibly suffer cumulative brain damage culminating in dementia.
17. In 1928 Martland first mentioned the term "punch drunk" and drew attention to a "peculiar condition among prize fighters". He described the development of Parkinsonian features, tremor, sometimes vertigo and deafness, and marked mental deterioration. The syndrome became known as dementia pugilistica (DP) or chronic traumatic brain encephalopathy (or injury). Little published work on the matter beyond case studies appeared until the late 1980s, when neuropathological techniques allowed studies of the post-mortem brain. However, the sum total of evidence is based on only a few brains. At first the evidence suggested that the histology of DP was unique and specific. Later studies, however, suggested that DP and Alzheimer's disease are not reliably distinguishable under the microscope.
18. More significantly, from the point of view of prescription, the Council received expert evidence that DP cannot be distinguished reliably from other forms of dementia in life. This precludes prescription on the basis of unique clinical features. The Council therefore sought epidemiological evidence on risk of dementia in boxers relative to other groups of workers.
19. Since the 1980s, there have been a number of studies of varying quality suggesting abnormal EEGs (electrical traces of brain activity), neurological, neuropsychological and pathological signs in boxers, but the Council found none concerning clinically overt dementia.

20. In the absence of relevant research in boxers, the Council considered whether prescription might be possible based upon a wider reading of the literature. Many general population studies have investigated whether head injury might lead to dementia, providing a richer literature base. In particular, the Council considered two large systematic reviews based upon 18 case-control studies of trauma and Alzheimer's disease.
21. In the earlier of the two reviews (based upon the first 11 case-control studies), the estimated relative risk of dementia following head injury sufficient to induce unconsciousness was more than doubled after allowing for a family history of dementia and alcohol consumption. The second review, which considered an additional seven studies, suggested a somewhat lower relative risk overall (increased 1.6-fold), with no excess risk in women but a more than doubling of risk in men.
22. In the first review paper a much stronger association was found with recent head trauma leading to unconsciousness than with head trauma more than 10 years previously.
23. These reviews and other studies in the area have provoked considerable debate. Case-control studies are based on retrospective data collection (the history of injuries in cases is obtained after the diagnosis has been made). One scientific concern is that the reporting of injury may be biased, unconsciously, by the search that relatives may make in their minds to explain the onset of Alzheimer's disease in a family member. Recall of head injury may be stronger for the case group than for healthy controls (this is sometimes called reporting bias). In addition, head injury predating the onset of a diagnosis of Alzheimer's disease could in fact reflect the early stages of undiagnosed disease and the greater propensity of the confused to fall and injure themselves. The observation that risks were greater for recent head trauma than for distant injury may be a pointer to bias of this kind in the research reports.
24. On balance, the Council considered that the epidemiological evidence in boxers was insufficient to recommend prescription. It also felt that, despite wider evidence on head injury and dementia suggestive of a hazard, there were not sufficient grounds to advocate prescription for professional boxers. The issue remains one of active research interest.
25. However, the Council was advised that a blow to the head that leads to traumatic brain injury may be covered under the IIDB accident provisions. Such cases are assessed on an individual basis; injuries arising during work as a professional boxer would not be excluded from consideration provided that other general conditions of the scheme were met.

Conclusion

26. At present, the evidence base on head injury in boxing and subsequent neurological damage, including dementia, is insufficient in quality and quantity for the Council to recommend prescription. It will continue to monitor further research in the area.

The evidence on dementia and heading footballs

27. The Council also considered whether the heading of footballs could cause chronic cumulative injury leading to dementia. Evidence is limited to a few small cross-sectional studies of retired elderly footballers. As with boxing, no high quality studies have considered dementia as a clinical end point. A wide range of neuropsychometric tests have been used, as well as a few studies exploring neuroimaging findings (brain scans). Brain atrophy (shrinkage) has been found occasionally.
28. Collectively, however, these studies have several limitations including small sample size, the relative youth of those studied, the difficulty of finding appropriate comparators and the problem of accounting for baseline (pre-morbid) differences from other comparative groups. These limitations have been extensively discussed by others.
29. The experts who were consulted informed the Council that no robust evidence exists that footballers are at extra risk of dementia from heading a football. Exposures in general are likely to be substantially lower than for boxers and to have lessened with time (owing to the replacement of heavy, leather footballs with modern, lighter versions).

Conclusion

30. The Council has concluded that current scientific evidence is insufficient to establish a causal link between dementia and heading footballs, either via the accident or prescription route.

Osteoarthritis

31. Osteoarthritis is a common disabling disorder in the general population. Pathologically it is a disease of synovial joints, with loss of articular cartilage and simultaneous overgrowth of new bone and remodelling. The diagnosis is usually based on clinical symptoms (of pain, stiffness and impaired mobility) and characteristic radiological changes in joints. Severity of symptoms and radiological change tend to correlate, but not perfectly in individual cases.
32. Traditionally, osteoarthritis is subdivided into primary or idiopathic disease (i.e. cause unknown), and secondary (due to an underlying condition). Most cases are considered to be primary and are particularly associated with ageing (by age 65 more than 80% of the population have radiological changes of osteoarthritis). Prominent causes of secondary disease include physical trauma (including fractures around the joint), infection, and congenital orthopaedic conditions.

The evidence on osteoarthritis of the hip and knee in footballers

33. There have been numerous studies on osteoarthritis and its causes, including some investigations in footballers.
34. Considering first the evidence on the accident route to benefit, a clear link exists between significant traumatic injury to the hip or knee joint (including operative procedures following sporting injuries) and subsequent development of osteoarthritis. In particular, injuries to the meniscus or ligaments of the knee in footballers are often followed by osteoarthritis in later life. Cases can arise within as little as ten years following the initiating trauma. Such accidents and their consequences are considered under the accident provisions, provided that other general conditions of the IIDB scheme are met.
35. A separate question concerns whether osteoarthritis of the hip or knee can be prescribed as a disease in footballers (i.e. outside the accident provisions and in the absence of a traumatic joint injury). As the clinical and radiological features of osteoarthritis in sportsmen and sportswomen are indistinguishable from those in the general population, prescription would require robust evidence of a doubling or more of risk of hip or knee osteoarthritis in footballers as compared with other working groups. The Council's literature review examined this specific question.
36. Several studies were found of football and risk of lower limb osteoarthritis in the absence of a significant identifiable single injury. In general however, the evidence did not prove compelling. Many studies were small in size or suffered from design and methodological limitations. Some failed to include a control group and some relied on self-reported diagnoses. Only a few longitudinal studies were identified and for these follow-up was generally short with significant attrition rates. Studies tended to differ in the criteria for subject selection and clinical end-points. A few of the smaller enquiries suggested a doubling of risk under some circumstances, but all reports suffered the limitation from the Council's viewpoint of failing to define clearly the qualifying exposure in terms of the requisite nature, level and duration of play at which risks were at least doubled. Many studies classified players in simple terms as 'elite' and 'non-elite' without discussing duration or intensity of training or playing career.

37. The Council received expert evidence that there was scientific uncertainty about the long-term consequences of physical exercise on lower limb joint disease. Some suggestion exists that elite athletes may develop more osteoarthritis over time, while recreational activities may confer a protective benefit; but this is still an active area of research.

Conclusion

38. Osteoarthritis of hip or knee can certainly follow significant joint injury and may be considered under the accident provisions. However, current evidence does not support prescription of osteoarthritis of the hip or knee joint in employed earners who are professional footballers.

Head injury and jockeys

39. The Council's attention was drawn to the substantial risk of head injury in professional jockeys. It was decided therefore to undertake a supplementary literature search to determine if the risk of dementia is increased in this occupation. No studies were found considering dementia and employment as a jockey. However, as with boxing, where normal qualifying conditions are met, accidental injury in jockeys may be considered under the accident provisions.

Motor neurone disease in footballers

40. Motor neurone disease is selective loss of motor neurones (nerves that innervate the muscles) resulting in weakness and wasting of the voluntary muscles of the upper and lower limbs, head and neck. Over recent years there has been considerable research interest in motor neurone disease and its risk factors.
41. A possible association with sport dates back to the American baseball star, Lou Gehrig, who developed amyotrophic lateral sclerosis (ALS), a variant of motor neurone disease, now known eponymously in the US as Lou Gehrig Disease. Other recent reports of an increased prevalence of ALS in Italian football players encouraged the Council to consider the evidence for prescription as part of this review.
42. The Council found, however, that research findings were conflicting. More recent work did not confirm the earlier observations that had suggested an increased risk. The rarity of the disorder limits interpretation of research findings, as few studies have sufficient statistical power to rule out the effects of chance. No evidence was found to suggest an occupational mechanism for this disorder in professional sportsmen and sportswomen. The Council will continue to monitor the literature.

Recommendations

43. Current evidence does not support the addition of dementia in professional boxers, footballers or jockeys to the list of prescribed diseases. No compelling evidence was found to recommend prescription for motor neurone disease in footballers.
44. Traumatic injury to the hip or knee (e.g. fractures involving the joint, cartilage tears or surgery) is often followed in later life by joint osteoarthritis. The Council believes that such events among professional footballers could be considered in qualifying cases under the accident provisions. At present however, there is insufficient evidence to recommend prescription of osteoarthritis of the hip and knee in footballers.

APPENDIX 1

The legal requirements for prescription

1. The Social Security Contributions and Benefits Act 1992 states that the Secretary of State may prescribe a disease where he is satisfied that the disease:
 - a) ought to be treated, having regard to its causes and incidence and any other relevant considerations, as a risk of the occupation and not as a risk common to all persons; and
 - b) is such that, in the absence of special circumstances, the attribution of particular cases to the nature of the employment can be established or presumed with reasonable certainty.
2. In other words, a disease may only be prescribed if there is a recognised risk to workers in an occupation, and the link between disease and occupation can be established or reasonably presumed in individual cases.
3. In seeking to address the question of prescription for any particular condition the Council first looks for a workable definition of the disease. Then it searches for a practical way to demonstrate in the individual case that the disease can be attributed to occupational exposure with reasonable confidence. For this purpose, reasonable confidence is interpreted as being based on the balance of probabilities according to available scientific evidence. If the condition might result from occupational exposure in the absence of an identifiable accident, the Council must consider whether it should be included in the list of diseases that are prescribed for benefit purposes. In these circumstances, it may be possible to ascribe a disease to a particular occupational exposure in two ways – from specific clinical features of the disease or from epidemiological evidence that the risk of disease is at least doubled by the relevant occupational exposure.

Basis of framing a recommendation on prescription

4. For some diseases attribution to occupation may be possible from specific clinical features of the individual case. For example, the proof that an individual's dermatitis is caused by his occupation may lie in its improvement when he is on holiday, and regression when he returns to work, and in the demonstration that he is allergic to a specific substance with which he comes into contact only at work. It can be that the disease only occurs as a result of an occupational hazard (e.g. coal workers' pneumoconiosis).
5. Other diseases are not uniquely occupational, and when caused by occupation, are indistinguishable from the same disease occurring in someone who has not been exposed to a hazard at work. In these circumstances, attribution to occupation on the balance of probabilities depends on epidemiological evidence that work in the prescribed job, or with the prescribed occupational exposure, increases the risk of developing the disease by a factor of two or more. The requirement for, at least, a doubling of risk is not arbitrary. It follows from the fact that if a hazardous exposure doubles risk, for every 50 cases that would normally occur in an unexposed population, an additional 50 would be expected if the population were exposed to the hazard. Thus, out of every 100 cases that occurred in an exposed population, 50 would do so only as a

consequence of their exposure while the other 50 would have been expected to develop the disease, even in the absence of the exposure. Therefore, for any individual case occurring in the exposed population, there would be a 50% chance that the disease resulted from exposure to the hazard, and a 50% chance that it would have occurred even without the exposure. Below the threshold of a doubling of risk only a minority of cases in an exposed population would be caused by the hazard, and individual cases therefore could not be attributed to exposure on the balance of probabilities. The epidemiological evidence required should ideally be drawn from several independent studies, and be sufficiently robust that further research at a later date would be unlikely to overturn it

APPENDIX 2

Annex of consultations with experts

Mr John Bramhall	Senior Executive, Professional Footballers' Association
Dr Simon Kemp	Medical Advisor to the Rugby Football Union
Professor Andrew Lees	Neurologist, National Hospital for Neurology & Neurosurgery Editor of the Journal of Neurology, Neurosurgery & Psychiatry Medical Advisor to the British Boxing Authority
Professor Paul McCrory	Neurologist and Sports Physician Editor of the British Journal of Sports Medicine

Details of the scientific references that are referred to in this report are available from the IIAC Secretariat on request.

