ORIGINAL ARTICLE

Epidemiology of medically treated sport and active recreation injuries in the Latrobe Valley, Victoria, Australia

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Objective: To quantify and describe medically treated sport and active recreation injuries in a defined region of the Latrobe Valley from 7 November 1994 to 6 November 1995.
Method: A geographic target area was defined, restricted to the six postcodes that fell wholly within the catchment area of the Latrobe Regional Hospital. Data describing medically treated sport and active recreation injuries to Latrobe Valley residents aged over 4 years (about 70 000) were selected by postcode from three sources: the Victorian Admitted Episodes Dataset (hospital admissions), the Victorian Injury Surveillance System (presentations to hospital emergency departments), and the Extended Latrobe Valley Injury Surveillance (ELVIS) project (presentations to general practitioners).
Results: At least 2300 cases of medically treated sport and active recreation injury were recorded. This corresponds to a hospital admission rate of 16/10 000 population, emergency department presentation rate of 169/10 000 population, and a general practitioner presentation rate of 187/10 000 population. There were more male patients than female, and younger age groups were also overrepresented, but these data may reflect the greater participation of these groups in sport and active recreation. Australian football was associated with the highest number of injuries (accounting for 24.0% and 22.0% of presentations to emergency departments and general practitioners respectively) followed by cycling (15.7% and 12.6%) and basketball (17.5% and 13.5%).
Conclusions: This study shows that routine health sector data collections in defined populations can provide useful information on the size, distribution, and characteristics of the problem of sport and active recreation injuries at the community level. However, all current health sector systems for injury data collection and surveillance require attention to improve case capture and identification and data quality.

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Over recent years, increasing attention has been directed towards describing the size and nature of the sports injury problem in Australia.[1–3] Sports injuries occur across a range of activities including formal (competitive) and informal sport, school sport, active recreation, fitness activities, and general physical activity. Sports injury is recognised as a public health priority, notwithstanding the well documented limitations of available data.[2–4]

Australian research is limited to a few studies that have described sports injuries presenting for treatment in specific medical settings: hospital emergency departments,[4 5] sports medicine clinics,[6] and general practice clinics.[7] One recent Western Australian study described injuries in a cohort of sports participants of four popular sports followed prospectively over two seasons,[8] but there are no comprehensive studies in well defined populations.

The Latrobe Valley region in Victoria is the only geographical area in Australia in which all medically treated sporting and recreational injuries have been recorded in a defined population for a 12 month period (1994–1995).[9] In addition to routine hospital surveillance data (admissions and emergency department (ED) presentations), the Extended Latrobe Valley Injury Surveillance (ELVIS) project collected data on most injury presentations to general practitioners (GPs) during the same period.[10]

The aims of this study were to: (*a*) quantify and describe injuries from sport and active recreation that were treated medically in a defined region of the Latrobe Valley over a 12 month period; (*b*) report rates of injury per 10 000 residents and construct a pyramid of medically treated sports injuries.

METHODS

The study area was restricted to six postcodes that fell wholly within the catchment area of the Latrobe Regional Hospital (3825, 3840–3842, 3844, 3869–3870). All residents aged over 4 years were eligible for inclusion.

Data on sporting and recreational injuries that received medical treatment were obtained from three sources: the Victorian Admitted Episodes Dataset (VAED; hospital admissions), the Victorian Injury Surveillance System (VISS; hospital ED presentations), and the ELVIS project (GP presentations). No sports medicine facility operated in the Latrobe Valley during the study period. All eligible patients recorded in these databases for the period 7 November 1994 to 6 November 1995 were selected. All pedal cycling related injuries were included, as it has been estimated that over 86% of all cycle use in Australia is for sport, exercise, or recreational purposes, rather than commuting.[4]

Hospital admissions

The VAED is a collection of data describing admissions to Victorian hospitals. Injury cases are coded with an external cause of injury code (E-code) under the International classification of diseases system (ICD-9-CM). Unfortunately, the classifications available to identify and describe cases of sport

Abbreviations: ELVIS, Extended Latrobe Valley Injury Surveillance; GP, general practitioner; VAED, Victorian Admitted Episodes Dataset; VISS, Victorian Injury Surveillance System; ED, emergency department; ISIS, Injury Surveillance Intelligence System; CI, confidence interval

Table 1 Major external causes of sport and active recreation injuries resulting in hospital admission or general practitioner presentation in Latrobe Valley residents aged over 4 years (7 November 1994 to 6 November 1995)*

External causes of injury or ICD9 E-code group	E-codes	Hospital admissions (VAED) No	Hospital admissions (VAED) % (95% CI)	GP presentations (ELVIS) No	GP presentations (ELVIS) % (95% CI)
Animal riding (horseriding)	(810.5, 811.5, . . ., 825.5) (826.2, 827.2, . . ., 829.2)	11	9.8 (4.3 to 15.3)	20	1.7 (1.0 to 2.5)
Pedal cycling	(800.3, 801.3, . . ., 807.3) (810.6, 811.6, . . ., 825.6) (826.1, 827.1, . . ., 829.1)	22	19.6 (12.3 to 27.0)	133	11.6 (9.8 to 13.5)
Water skiing	(830.4, 831.4, . . ., 838.4) (910.0)	0	–	2	0.2 (0.0 to 0.4)
Swimming	(830.5, 831.5, . . ., 838.5)	0	–	0	–
Diving	(883.0, 910.1, 910.2)	1	0.9 (0.0 to 2.6)	9	0.8 (0,3 to 1.3)
Fall on same level (sport)	886.0	13	11.6 (5.7 to 17.5)	44	3.8 (2.7 to 5.0)
Struck/crush (sport)	917.0	44	39.3 (30.2 to 48.3)	380	33.2 (30.4 to 35.9)
Overexertion/strenuous movements†	927.0	21	18.8 (11.5 to 26.0)	558	48.7 (45.8 to 51.6)
Total		112		1146‡	

*This category may include cases from other than sport activities; these cannot be separated out.
†There were 1146 GP presentations when data were selected by E-codes. When data were selected by Injury Surveillance Intelligence System (ISIS) code there were 1003 cases. Because more information can be gained from ISIS coding, the smaller dataset was subjected to detailed analysis.
‡Victorian Injury Surveillance System (VISS) hospital emergency department data are not included in this table because the system does not use the ICD9 E-code classification system.
VAED, Victorian Admitted Episodes Dataset; GP, general practitioner; ELVIS, Extended Latrobe Valley Injury Surveillance; CI, confidence interval.

and recreation injury on the database are limited (table 1). The selection of sports injury cases is restricted to two main E-codes: E886.0 (fall on the same level from collision, pushing or shoving by or with other person in sports); E917.0 (striking against or struck accidentally by objects or persons in sports). The available codes for recreational injury are also restricted and only cover animal riding (predominantly recreational horse riding), pedal cycling, water skiing, swimming, and diving. All cases classified under E927.0 (overexertion and strenuous exercise) were included, although a small proportion may not be related to sport and active recreation. Private hospital admissions, readmissions within 30 days, medical injuries, and late/adverse effects of injury cases were excluded from the analysis.

The number of injury cases recorded on the VAED represents 100% of all actual injuries admitted to hospital. However, cases of sports injury are underestimated because of the limitations of the coding system mentioned above.

ED presentations

VISS, as it operated in the mid-1990s, collected data on injury presentations to the EDs of five participating hospitals, including the Latrobe Regional Hospital. A standard instrument for injury surveillance[11] which collected demographic data and information relating to the injury event such as the mechanism of injury and associated factors was used. On presentation to an ED, the injured patient (or parent/carer) and doctor completed sections of the form, on a voluntary basis.

An audit of ED injury surveillance in the Latrobe Regional Hospital[12] determined that the cases recorded on the VISS database represented 85% of all actual ED presentations for treatment of injuries and 100% of all actual cases subsequently admitted to hospital. However, there may be some discrepancy in the admission rate recorded on the VISS database compared with the VAED. This is because cases were selected on postcode of residence and therefore admissions recorded on the VAED may have occurred through hospital EDs that were not part of the VISS system.

The VISS used Injury Surveillance Intelligence System (ISIS) codes[11] to generate incidence distributions to compare the nature and extent of injury presentations. Sports injury cases were selected on the basis of ISIS context/activity codes 102 and 103 (bicycling) and 301–303, representing organised competition or practice, informal sport, and sport not specified respectively. Active recreation cases were identified by factor codes that covered injuries associated with horseback riding, roller skating, trampolining, swimming, skateboarding, and snow skiing. Up to three injuries may be recorded per case, and the system does not allow extraction by primary diagnosis.

GP presentations

The ELVIS project, established by the Central West Gippsland Division of General Practice, collected injury data through a research network of GPs.[10] The process for VISS ED data collection was refined and modified for use in the general practice setting. Data on injury presentations to general practice were manually entered on a standardised form, different sections of which were completed by the patient and GP. Sixty four of the 66 GPs (97%) in the division participated in the ELVIS project through 18 general practices. An audit of the ELVIS system determined that the number of injury cases recorded on the ELVIS database represented 77% of all actual GP consultations for injury in the 12 month data collection period.[10]

ISIS classification was used, and cases were selected as described above for the VISS ED presentations. The ELVIS data were also manually assigned an ICD9 E-code for cause of injury, which allowed comparison with hospital admissions data on injury causation.

Data analysis

A descriptive analysis of the data for sports injuries from each of the three injury databases was undertaken. Data from these collections are presented as incidence and proportions, with associated 95% confidence intervals. It is not possible to combine data from the three databases because of the different methodologies and classification systems used to identify and code injury data, and there were no identifiers to enable data linkage.

The Australian Bureau of Statistics 1995 census estimates that there were 69 663 people aged over 4 years usually resident in the six target postcodes approximately midway through the data collection period (June 1995). The incidence of medically treated injuries incurred during sport or active recreation in the Latrobe Valley was calculated per 10 000 population (aged over 4 years). The number of cases reported from each database was multiplied by the inverse of the expected capture rate from that source to estimate the true number of cases. For ED data, this was done separately for the cases in which the patient was admitted to hospital or not because of their differing case capture rates. It was not possible to take into account the age and sex distributions in this

Table 2 Body sites injured in sport and active recreation in LaTrobe Valley residents aged over 4 years (7 November 1994 to 6 November 1995)

Body site	Hospital admissions (VAED) (n=112)	Emergency department presentations (VISS) (n=1321 injuries)*	General practitioner consultations (ELVIS) (n=1003)
Upper extremity	33.0 (24.3 to 41.7)	39.0 (36.4 to 41.6)	38.4 (35.4 to 41.4)
Head and face	29.5 (21.0 to 37.9)	20.1 (18.0 to 22.3)	11.8 (9.8 to 13.8)
Lower extremity	24.1 (16.2 to 32.0)	31.2 (28.7 to 33.7)	39.3 (36.3 to 42.3)
Trunk	5.4 (1.2 to 9.5)	5.6 (4.4 to 6.8)	8.4 (6.7 to 10.1)
Other/unspecified	8.0 (3.0 to 13.1)	4.1 (3.0 to 5.2)	2.2 (1.3 to 2.1)
Total	100.0	100.0	100.0

Values are percentages (95% confidence interval).
*Up to three injuries can be recorded per case in the VISS database (n=1179 cases).
VAED, Victorian Admitted Episodes Dataset; VISS, Victorian Injury Surveillance System; ELVIS, Extended Latrobe Valley Injury Surveillance.

factoring up because the case capture rate information was only available as an overall figure. The ratio of the incidence of hospital admissions to the incidences of ED and GP presentations was calculated to generate a sports injury "pyramid".

RESULTS

Hospital admissions

In the study period, there were 112 hospital admissions for injury from sport or active recreation in the Latrobe Valley (table 1). This corresponds to an annual incidence of 16 sports injuries requiring hospital admission per 10 000 population aged over 4 years (95% confidence interval (CI) 14.4 to 42.1).

In 70% of cases requiring hospital admission, the patient was male. Two thirds were in the younger age groups: 36.6% were in the 5–14 year old age group (65.9% were male); 30.0% were 15–24 year olds (73.5% male).

The major causes were "being struck or crushed during sport" (39.3%), cycling (19.6%), and "overexertion and strenuous movements" (18.8%) (table 1). Injuries occurred most often to the upper extremities (33.0%) and the head/face (29.5%) (table 2). The most common types of injury were fracture (44.6%), intracranial injury (17.9%), and dislocation (9.8%) (table 3).

The length of hospital stay provides an indication of the severity of the injury: 86% of stays were less than two days and only 3.6% were more than eight days.

ED presentations

There were 1179 ED presentations for sport injury in the Latrobe Valley in the study period. This corresponds to an annual incidence of 197 persons attending a hospital ED for treatment per 10 000 population aged over 4 years (95% CI 123.2 to 254.9).

The sports most often associated with ED presentations were Australian football (24.0%), cycling (15.7%), and basketball (13.8%) (table 4). In 73%, the patient was male. Cases were predominantly in three age groups: 10–14 years (29.5%), 15–19 years (19.5%), and 20–24 years (15.9%).

The VISS allows up to three separate injuries to be recorded per case. Most injuries occurred to the extremities and were fairly evenly divided between the upper (39.0%) and lower (31.2%) extremities (table 2). Sprain/strain (23.3%) was the most common type of injury (table 3). The most common specific injuries were ankle sprains/strains (9.0%), knee sprains/strains (4.0%), fractures of the radius/ulna (4.0%), face/scalp lacerations (4.0%), and finger fractures (3.0%).

A high proportion (80%) of people who attended an ED with a sports injury were subsequently admitted to hospital. Further examination of the data shows rugby injuries to result in the highest rate of hospital admission (16%), followed by trampolining (15%), soccer and horse riding (both 14%), cycling (11%), and football (5%). Just over half (52.8%) of ED presentations required major treatment—that is, they required follow up or referral usually to a GP (25.5%), a review in the ED (17.0%), or another type of referral (8.0%). Approximately one third of presentations (34.1%) required minor treatment, that is medical assessment only or treatment without follow up, and 5.5% required no treatment.

Table 3 Nature of injuries in sport and active recreation in LaTrobe Valley residents from 7 November 1994 to 6 November 1995

Nature of injury	Hospital admissions (VAED) (n=112)	Emergency department presentations (VISS) (n=1321 injuries)*	General practitioner presentations (ELVIS) (n=1003)
Fractures	44.6 (35.4 to 53.8)	17.8 (15.7 to 19.9)	11.4 (9.4 to 13.3)
Intracranial (not skull fracture)	17.9 (10.8 to 25.0)	–	–
Dislocations	9.8 (4.3 to 15.3)	3.1 (2.2 to 4.0)	1.5 (0.7 to 2.2)
Open wound	6.3 (1.8 to 10.7)	–	–
Sprains/strains	6.3 (1.8 to 10.7)	23.3 (21.0 to 25.6)	38.8 (35.8 to 41.8)
Bruises, haematomas, crushing	3.6 (0.1 to 7.0)	14.1 (12.2 to 16.0)	23.6 (21.0 to 26.3)
Internal (chest/abdomen/pelvis)	3.6 (0.1 to 7.0)	–	–
Abrasion	–	6.1 (4.8 to 7.3)	4.6 (3.3 to 5.9)
Inflammation	–	12.9 (11.1 to 14.7)	8.0 (6.3 to 9.7)
Cuts and laceration	–	16.3 (14.3 to 18.3)	7.0 (5.4 to 8.6)
Other injuries	8.0 (3.0 to 13.1)	6.5 (5.2 to 7.8)	5.2 (3.8 to 6.6)
Total	100.0	100.0	100.0

Values are percentages (95% confidence interval).
*Up to three injuries can be recorded per case.
VAED, Victorian Admitted Episodes Dataset; VISS, Victorian Injury Surveillance System; ELVIS, Extended Latrobe Valley Injury Surveillance.

Table 4 The sport and active recreation activities most often associated with emergency department and general practitioner presentations for injury in LaTrobe Valley residents aged over 4 years (7 November 1994 to 6 November 1995)

Sporting activities	Emergency department presentations (VISS) (n=1179)	Rank	General practitioner presentations (ELVIS) (n=1003)	Rank
Australian football	24.0 (21.6 to 26.4)	1	22.0 (19.5 to 24.6)	1
Cycling	15.7 (13.6 to 17.8)	2	12.6 (10.5 to 14.6)	3
Basketball	13.8 (11.9 to 15.8)	3	17.5 (15.2 to 19.9)	2
Netball	6.9 (5.4 to 8.3)	4	6.7 (5.1 to 8.2)	4
Cricket	6.4 (5.0 to 7.8)	5	5.5 (4.1 to 6.9)	6
Soccer	5.4 (4.1 to 6.7)	6	5.9 (4.4 to 7.3)	5
Horseback riding	4.7 (3.5 to 6.0)	7	2.6 (1.6 to 3.6)	8
Rollerskating/blading	4.4 (3.2 to 5.6)	8	2.2 (1.3 to 3.1)	10
Trampolining	3.3 (2.3 to 4.3)	9	2.1 (1.2 to 3.0)	
Rugby	2.6 (1.7 to 3.5)	10	1.9 (1.1 to 2.7)	
Baseball	1.5		3.2 (2.1 to 4.3)	7
Tennis	1.5		2.3 (1.4 to 3.2)	9
Other	9.7		15.6 (13.3 to 17.8)	
Total	100.0		100.0	

Victorian Injury Surveillance System; ELVIS, Extended Latrobe Valley Injury Surveillance.

GP presentations

There were 1003 presentations to GPs for injuries associated with sport and active recreation. This corresponds to an annual incidence of 187 persons presenting to a GP for a sports injury per 10 000 resident population aged over 4 years (95% CI 160 to 214).

Australian football (22.0%), basketball (17.5%), and cycling (12.6%) were the sports most often associated with GP presentations (table 4). The major causes of injury were "overexertion and strenuous movement" (48.7%), "struck/crush in sport" (33.2%), and pedal cycling (11.6%) (table 1). Two thirds of patients were male. The age groups that accounted for most injuries were 10–14 year olds (34.2%) and 15–19 year olds (16.7%).

The most common types of injury presentation were sprains/strains (38.5%, mostly to the lower extremity), bruising (23.6%, commonly to the head/face), fracture (11.4%, mostly to the upper extremities), and inflammation (8.0%) (table 3). Overall, the lower and upper extremities were the most commonly injured body sites (39.3% and 38.4% respectively), followed by the head and face (11.8%), and trunk (8.4%) (table 2).

Almost as many GP presentations required minor treatment (41.8%, treated without further referral) as more major treatment (40.7%, treated with follow up or referral). An appreciable proportion required assessment only (17.5%). Two patients presenting to GPs were referred to an ED.

Injury pyramid

A pyramid of medically treated sports injuries was constructed for the Latrobe Valley. Over any 12 month period, for every 10 000 head of population in the Latrobe Valley, it can be expected that for each hospital admission for treatment of a sport injury, there will be 10.6 ED presentations and 11.7 GP presentations (1:11:12).

DISCUSSION

This is the first Australian study to report the incidence of sports injuries for a defined population. Available data indicate that there were at least 2300 medically treated sports injuries in the Latrobe Valley population of about 70 000 aged over 4 years during the period 7 November 1994 to 6 November 1995: 112 hospital admissions, 1179 ED presentations, and 1003 GP presentations. This corresponds to 272 cases per 10 000 persons.

This study confirms the findings of others that a substantial number of sports injuries are not treated at hospitals or EDs; instead they present to community based sources such as GPs or sports medicine clinics.[4 6 13–16] One British study found that about 75% of all reported sports injuries were not treated at an ED or admitted to hospital.[17] In a study of Australian football injuries in children and adolescents, EDs treated only 28% of all reported injuries.[15]

An injury pyramid was constructed to describe the profile of injuries within the Latrobe Valley. It is estimated that over a 12 month period, per 10 000 population, 16 people will be admitted to hospital for treatment for a sports injury, 169 will present at an ED, and 187 people will receive treatment from a GP (adjusted proportions 1:11:12). These figures suggest that most sports injuries presenting to clinical services are mild to moderately severe, which is also indicated by the short stay (fewer than two days) of most admitted cases. As would be expected, fractures and intracranial injuries comprise a higher proportion of hospital admissions than ED and GP presentations. Injuries presenting to the ED and general practice are usually sprains and strains, although fractures are not uncommon. The substantial number of fracture cases treated by GPs is noteworthy as it is often assumed that injuries of this severity generally present to hospital EDs.

Our data suggest a higher rate of hospital admission for sports injuries than other studies, although they are consistent with previous Australian data.

Finch *et al*[4] described sport and active recreation ED presentations across Australia over a four year period. Some 8% of the injured adults were subsequently admitted to hospital for further treatment, compared with just over 14% of children aged <15 years. In contrast, among sports injury cases presenting to an ED, only 2% of cases in Glasgow,[18] 5% of child cases in Canada,[19] and 2% of 10–19 year olds presenting in Columbia, USA[20] required admission to hospital.

Men and boys were much more likely to present for medical treatment of a sports injury than women or girls, and younger age groups were also overrepresented in injury data, but these differences may just reflect the greater participation of these groups in sport and active recreation.

The available data, limited to ED and GP presentations, show that Australian football is the sport most often associated with medically treated injuries in Latrobe Valley, accounting for 22–24% of presentations. Cycling, basketball, netball, cricket, and soccer were also associated with appreciable (and similar) proportions of injuries presenting to both EDs and GPs. Care should also be exercised in drawing inferences from these findings because comparisons are based solely on injury incidence. A fairer but more complex method of determining the relative risk of injury in the various sporting and recreational activities would factor in participation data (to estimate the risk per participant) and, preferably, exposure or time at risk data (estimating risk per time unit).[21] These adjustments are important because, in general, sports with the highest numbers of participants have the highest incidence of injuries, especially in communities where a small number of sports dominate. Nonetheless, popular sports that produce sizeable proportions of the injury problem in a given community are legitimate targets of prevention efforts, even if less popular sports are shown to carry greater risks of injury when data are adjusted for exposure.

Although the three data sources used for this study provide rich information on the size and nature of the sports injury problem, they have limitations.[2] Firstly, the VAED underestimates hospital admissions for sports injuries because, under ICD9-CM, sports specific E-codes are limited and restrict the counting of hospital admissions. Secondly, the data only cover the injuries for which medical treatment was sought from hospitals and GPs. Many sports injuries, particularly overuse and other soft tissue injuries, are attended to by other practitioners such as sports medicine specialists, physiotherapists, chiropractors, masseurs, and sports first aiders, or are self treated. The available statistics therefore probably represent a fraction of those injured in sport and active recreation. Indeed, comparison of the health sector data with results from a population survey conducted in the same region indicates that the available injury databases describe less than 30% of all self reported sports injury cases.[22] Despite these limitations, health sector data are essential for quantifying and describing injuries that are severe enough to require medical treatment, and they assist the identification of high risk sport and active recreation activities.[23]

In summary, this study shows that routine health sector data collections in defined populations can provide useful information on the size, distribution, and characteristics of the sports injury problem at the community level. However, all current health sector systems for collection of injury data require attention to improve case capture and identification and data quality. Recent coding changes are improving the potential to identify sports injury cases among all cases admitted to hospital. The new ED surveillance system operating across 25 public hospitals has extended Victoria's capacity to provide injury data for defined populations, but identification of the sport or recreation activity involved is inconsistent at present. There has been some expansion of routine collection of injury data at the level of general practice in Victoria, modelled on ELVIS. These clinical sources provide some of the information needed to guide programme planning and implementation in the area of community sports safety.

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Take home message

If our figures are a true estimation of sports injury incidence, for every 10 000 head of population, we can expect that for each hospital admission for treatment of sport and active recreation injury, there will be 10.6 emergency department presentations and 11.7 general practitioner presentations (1:11:12).

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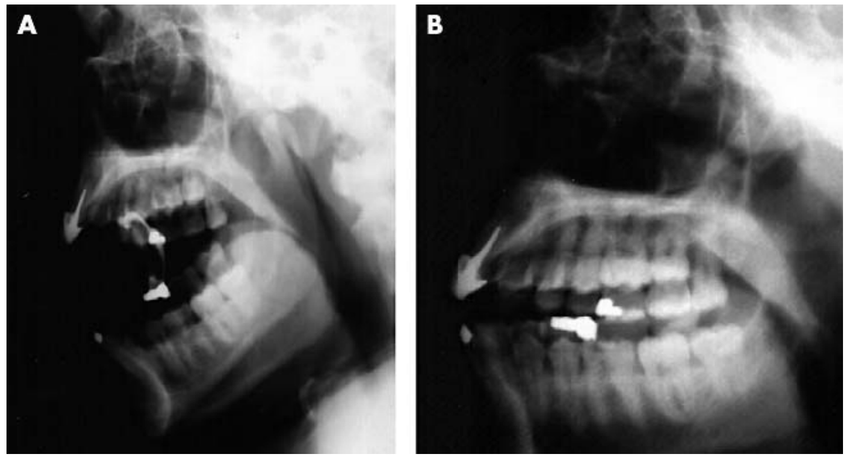

Figure 2 (A) Radiograph of a diver with a large plastic tube (40 mm diameter) inserted in the mouth. (B) The same diver with a standard mouthpiece inserted.

Scuba diving can induce stress of the temporomandibular joint leading to headache

In ordinary recreational scuba diving, many anatomical parts can be involved in disorders of cranial regions: ears and eyes are involved but also sinuses. Dental problems are generally involved in barotraumas because of bad dental fillings or other matters of interest to the general dental practitioner.[1] Very few papers have looked at the articular and periarticular problems of the temporomandibular joint (TMJ).[2]

Local factors such as joint laxity, anatomical factors, capsular or muscular inflammation, and articular stress of long duration resulting from holding the regulator mouthpiece in scuba diving or the snorkel mouthpiece in skin diving can lead to TMJ disorders including headaches and myalgic symptoms.[3]

We examined the biomechanics of the TMJ (fig 1) in relation to diving, particularly looking at the disc-condylar position during mouthpiece biting and with the mouth closed and wide open (submaximal opening). The aim was to see if during scuba diving the TMJ is maintained in a stressed position leading to pathology (myalgia, headaches, discal subluxations) under certain conditions.

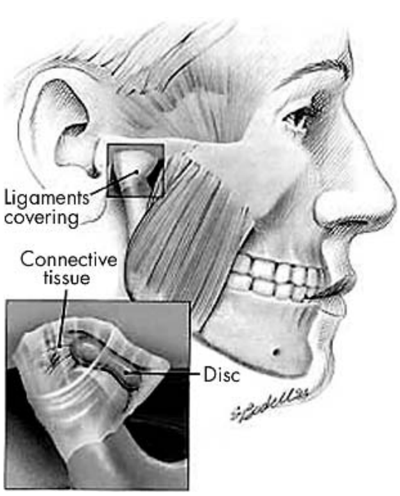

Figure 1 Diagram illustrating the structure of the temporomandibular joint.

Methods

To measure condylar and discal displacement in divers, we studied 30 TMJs in a population of 15 divers aged 18–55, including six women. None had symptoms of TMJ disorder such as joint noise, pain, or luxations. All were fully informed about the experimental paradigm and agreed to have magnetic resonance imaging (MRI) of both TMJs.

MRI was used so that the intra-articular disc and condyle body could be viewed in the same image and scale to allow angular measurements. Six sagittal and parasagittal slices were viewed on each side (T1 weighted sequences, performed with a 6.5 cm circular coil at each side of the head). All the procedures were consistent with actual TMJ MRI techniques. Measurements were made on the same subject in three standard mouth positions:

(1) Closed mouth (biting position)

(2) Mouth holding regular diving mouthpiece

(3) Mouth submaximally opened holding a 40 mm uncompressible non-magnetic plastic tube (fig 2)

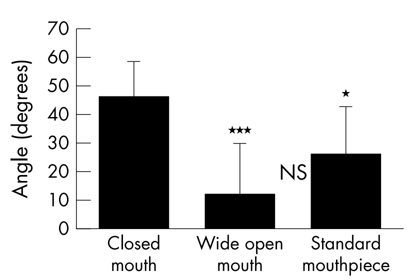

Figure 3 Angular variations between the condyle axis and the medial part of the disc. ***$p<0.001$; *$p<0.05$ compared with the closed mouth position.

The different angles calculated for the whole samples were computed for statistical analysis by standard procedures including mean, standard deviation, median, and analysis of variance after the Kolmogorov Smirnoff test for normality. Post-discriminant tests included Tukey-Kramer and Bonferroni.

Results

Figure 3 shows that there was a significant difference between the closed mouth position and the two other standard mouth positions (wide open, $p<0.001$; holding a standard mouthpiece, $p<0.05$), but no difference was found between the two latter positions.

Conclusions

From the results we cannot reject the hypothesis that the prolonged position of the TMJ during scuba diving may induce pain as the result of stress to the retrodiscal portion of the joint, which is near neurovascular elements. It is recommended that divers should be taught not to overstress the TMJ to avoid headache and other myalgic syndromes. The reader is referred to the paper on temporomandibular dysfunction in scuba divers by Aldridge and Fenlon (p ??) .

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Metabolic risks of completing Giro, Tour, and Vuelta in the same season

In a recent issue, Lucia *et al* suggested that an experienced professional cyclist can safely complete the three major cycling stage races (Giro d'Italia, Tour de France, and Vuelta a España) within the same season, over a five month period.[1] The authors reached this conclusion mainly on the basis of heart rate telemetry, showing that the total amount of near maximal exercise in athletes with a predominant team role as domestiques is relatively low and compatible with the high requirements of the three races. Although this observation may be true from a physical point of view, it does not consider several substantial biochemical aspects. A bulk of evidence indicates that strenuous and prolonged physical exercise leads to amplified muscle oxygen use, increased electron flux and leakage through mitochondria, and consequent overproduction of reactive oxygen species (ROS). The excessive ROS generation may overwhelm the scavenger capacity of the main antioxidant defences, inducing oxidative damage to lipids, proteins, and nucleic bases and promoting the development of severe and progressive degenerative disorders, such as aging, cancer, atherosclerosis, diabetes, and neurodegeneration. In addition, the oxidative stress following physical exercise has been associated with overtraining, decreased physical performances, muscular fatigue, inflammation, and damage, leading to a decline in fitness and athletic performance in the short term.[2] Therefore, although a trained athlete can probably fulfil the physical requirements of the three major cycling stage races over a very limited period of time, we suggest that the unfavourable metabolic effects of the increased ROS generation should be carefully considered and eventually prevented or counteracted. In this respect, we believe that a diet enriched in natural antioxidants from fruits and vegetables or the administration of dietary antioxidant supplements may be advisable in elite athletes routinely engaged in strenuous and prolonged physical exercise.[3]

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BOOK REVIEW

Lore of running, 4th edn.

T D Noakes. Human Kinetics Europe, £17.95, 2003, pp 944, hardcover. ISBN 0873229592

What are your favourite books of all time? Which books have changed your life? Many people include *Lore of running* among the answers to those questions. Approaching the 20 year anniversary of the genesis of this "runner's bible", Tim Noakes has released the extremely comprehensive, yet very practical 4th edition.

Unlike J K Rowling, who dices her adolescent psychology and astral physiology research into seven books and four movies, T D Noakes provides his reader with the equivalent of four substantial books within the covers of this 1277 page tome. Firstly, *Lore* is a fascinating historical biography of runners and running. The running reader loves to know the secrets of the champion's mind and motor, and *Lore* provides almost 200 pages of unique insights into the Who's Who of running, including Deerfoot (1861), Paavo Nurmi, Arthur Newton, Emil Zatopek, Jim Peters, Kip Keino, Bruce Fordyce, Grete Waitz, Robert De Castella, Carlos Lopes, Frank Shorter, to list just some. Noakes provides enough detail to satisfy the most diligent of trainers, yet weaves the psychological and personal insights with the training details to craft a fascinating tapestry. This part alone (Chapter 6, Learning from the experts) is worth the price of the book and is a substantial expansion and update from its popular predecessors in earlier editions of *Lore*.

Next, *Lore* provides up to date exercise related physiology and biochemistry in a manner that is understandable by those with, and without, training in the formal biological sciences. This has always made *Lore* unique among "running" books (it is so much more than that alone!). A particular feature of this edition is the quality of the artwork that explains the science, and the very useful case histories of how athletes have had their problems solved by sports science. In this part, an exercise physiologist outlines, for the first time, the dominant role played by the brain in determining performance in any form of physical activity.

The importance of this new model is illustrated in what I consider the 3rd book within *Lore*—a practical guide to training for and racing over distances from 10 k to the ultramarathon. When a patient presented asking my advice for the "Marathon of the sands" (a 7 day 150 mile race across the Sahara desert in Morocco, http://web.outsideonline.com/system/tv/mds99/), I dithered between making a psychiatric referral and lending my personal copy of *Lore*. It seems that the latter sufficed—an extremely happy (but thin, with big blistered feet) borrower returned the book saying it had been a crucial factor in his success. Where else does one find over 50 pages with eight different detailed training schedules dedicated to ultramarathon alone? Noakes himself acknowledges having run over 70 marathons, but given that this count credits each 92 km Comrades marathon as just one, his personal marathon experience is over 100. This, combined with his access to leading athletes and South Africa's tradition in endurance events, explains why *Lore* provides unique insight for the distance minded runner.

Finally, and importantly, *Lore* is a practical sports medicine book with almost 300 pages devoted to the role of ergogenic aids, tips on staying healthy, and discussion of the benefits and hazards of running. This section includes a self help approach to treating injuries, discussion of the most common injuries, and cutting edge research both from Noakes' own laboratory—for example, exercise associated collapse, avoiding water intoxication—and that of others whose work affects runners' health.

Those who have been fortunate enough to attend Noakes' (the Michael Moore of sports medicine (www.michaelmoore.com)) international conference presentations will be aware of his attention to detail and aesthetics, and this book mirrors that care. From the historical black and white prints of runners such as Nurmi to the clear, extremely informative figures, every page is an invitation.

Examples of boxed panels that will capture the curiosity of many include "the 15 laws of training", "animals with great athletic ability", "physiological explanations for the superior distance running ability of black africans". The section discussing Sir Roger Bannister's mental approach is compulsory reading. Also, *Lore* has international appeal—it is for runners whether they live in Aachen or Zyryanovo or any place between.

If you enjoyed a previous edition of *Lore* (as I have), you must see this 4th edition with its wonderfully expanded minibiographies, detailed schedules to help you with training and racing, and the exposition of crucial scientific data that have lain unexplored for 75 years. You are unlikely to need much convincing.

If you are new to *Lore*, but a runner, or friends with a runner, please take my advice to examine this masterpiece. You will be very pleased you did. *Lore* will add to your joy of running. This edition will again enhance the lives of many readers. I have presented copies to several close friends and graduating scientists and clinicians and I know they treasure it, as I do.

Analysis

Presentation	19/20
Comprehensiveness	20/20
Readability	18/20
Relevance	20/20
Evidence basis	17/20
Total	94/100

K Khan

CALENDAR OF EVENTS

The 7th Scandinavian Congress on Medicine and Science in Sports

25–27 March 2004, Stockholm, Sweden

Abstracts: deadline 15 January 2004

Further details: Email: ingrid.canholm-pluntky@kirurgi.ki; website: www.svenskidrottmedicin.org.se/scandinaviansportscongress

Medicare India

6–8 April 2004, New Delhi, India

This exhibition and conference will be held for the first time, following India's ambitious "health for all" programme launched in 2002.

Further details: Rob Grant, Kinex Log, 5 New Quebec Street, London W1H 7DD, UK; tel: +44 (0)207 723 8020; fax: +44 (0)207 723 8060; email: rob.grant@kinexlog.com; websites: www.medicare-expo.com and www.kinexlog.com

The 6th STMS World Congress on Medicine and Science in Tennis in conjunction with the LTA 2004 Sports Science, Sports Medicine and Performance Coaching Conference

19–20 June 2004, London, UK

Keynote speakers include Professor Per Renstrom (SWE), Professor Peter Jokl (USA), Professor Savio Woo (USA), Dr Carol Otis (USA), Dr Mark Safran (USA), Dr Ben Kibler (USA), Prof Bruce Elliott (AUS), and Professor Ron Maughan (UK).

Further details: Dr Michael Turner, The Lawn Tennis Association, The Queen's Club, London W14 9EG, UK; email: michael.turner@LTA.org.uk

The Leeds Sports Imaging Course

6–7 September 2004, Leeds, UK

This two day course is aimed at both radiologists and clinicians who are involved in sports imaging. The course will comprise an imaging and clinical overview of all relevant joint, bone and soft tissue sporting injuries.

The faculty will comprise internationally recognised skeletal imaging and clinical experts from the UK, Europe and North America who will deliver state of the art lectures and lead sessional discussions. Each session will cover the spectrum of injury for a specific anatomical area beginning with clinical lectures that will allow the subsequent imaging lectures to be placed in context. All aspects of imaging will be discussed but will concentrate on the use of ultrasound, conventional MR imaging and MR arthrography for the diagnosis, staging and prognosis of sporting injuries. Therapeutic image guided intervention using fluoroscopy, CT and ultrasound will also be demonstrated.

13 RCR category one CME credits have been awarded.

Further details: Carol Bailey, Course co-ordinator, MRI Department, B Floor, Clarendon Wing, Leeds General Infirmary, Leeds LS1 3EX; tel: +44 (0)113 3922826; fax: +44 (0)113 3928241; email: Carol.Bailey@leedsth.nhs.uk

BASEM Conference 2004

14–17 October 2004, Belfast, UK

Main themes: Overuse Sports Injuries and Muscle Injuries. Keynote speakers include: Chris Bradshaw, Medical Director, Olympic Park Medical Centre, Melbourne and Kim Bennell, Assistant Professor, School of Physiotherapy, Melbourne University.

Further details: Email: fionnuala.sayers@greenpark.n-i.nhs.uk

1st World Congress on Sports Injury Prevention

23–25 June 2005, Oslo, Norway

This congress will provide the world's leading sports medicine experts with an opportunity to present their work to an international audience made up of physicians, therapists, scientists, and coaches. The congress will present scientific information on sports injury epidemiology, risk factors, injury mechanisms and injury prevention methods with a multidisciplinary perspective. Panel discussions will conclude symposia in key areas providing recommendations to address the prevention issue in relation to particular injuries and sports.

Further details: Oslo Sports Trauma Research Centre and Department of Sports Medicine, University of Sport and Physical Education, Sognsveien 220, 0806 Oslo, Norway. Email: 2005congress@nih.no; website: www.ostrc.no

CORRECTION

Owing to the change over of typesetters at the BMJ Group the authors' corrections to the paper by Cassell *et al*, which was published in the October 2003 issue (Epidemiology of medically treated sport and active recreation injuries in the Latrobe Valley, Victoria, Australia *Br J Sports Med* 2003;**37**:405–409) were omitted. This mistake is much regretted and we would like to offer our sincerest apologies to the authors. The major error on page 407 of the Results section (ED presentations: first sentence of fourth paragraph) should read: Approximately 8% of people who attended an ED with a sports injury were subsequently admitted to hospital.

A fully corrected version of the paper will be posted on the web in the near future.

ECHO

Fitness to dive should rest on a clear CT chest scan

Please visit the *British Journal of Sports Medicine* website [www.bjsportmed.com] for a link to the full text of this article.

Professional divers should have a computed tomographic (CT) examination during their initial medical for certification to exclude conditions that can lead to fatal lung damage during diving. This is especially important if they smoke or have had chest infections, as one case series from Turkey has shown.

The three male divers were aged between 25 and 56 years with 6 months' to15 years' diving experience. Two were regular long term smokers, smoking 20 cigarettes/day for 20 years and 23-30 cigarettes/day for 10 years, respectively. Symptoms occurred during ascent from a dive and included chest pain, breathing difficulties, and—in two instances—neurological symptoms. All divers recovered eventually with treatment, but all were excluded from diving.

CT scans of the chest showed air cysts or bullae predisposing to pulmonary barotrauma that were simply not evident in plain chest *x* ray films for each diver. In one case a large apical bulla was present; in another an azygous lobe on the right side and many air cysts in both lungs; and in the third a small bleb in the upper right lung.

Smoking and lung infections increase the risk of air sacs or bullae developing in the lung. These in turn increase the risk of pulmonary barotrauma, a complication of which—arterial gas embolism—caused almost a third of deaths from diving, according to one study.

▲ *Occupational and Environmental Medicine* 2003;**60**:606–608.