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Sports Safety in Australia
AN UPDATE
July 2003
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<tr>
<td>ABS</td>
<td>Australian Bureau of Statistics</td>
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<tr>
<td>AFL</td>
<td>Australian Football League</td>
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<td>AFLMOA</td>
<td>Australian Football League Medical Officers Association</td>
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<td>AIPN</td>
<td>Australian Injury Prevention Network</td>
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<td>ASC</td>
<td>Australian Sports Commission</td>
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<td>ASIDD</td>
<td>Australian Sports Injury Data Dictionary</td>
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<td>ASIPT</td>
<td>Australian Sports Injury Prevention Taskforce</td>
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<td>GPs</td>
<td>General Practitioners</td>
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<td>ICD-10 AM</td>
<td>International Classification of Diseases Version 10 (Australian Modification)</td>
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<td>ICD-9</td>
<td>International Classification of Diseases Version 9</td>
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<td>IRR</td>
<td>Incidence rate ratio</td>
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<td>NCIS</td>
<td>National Coroners Information System</td>
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<td>NHMRC</td>
<td>National Health and Medical Research Council</td>
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<td>NIPAC</td>
<td>National Injury Prevention Advisory Committee</td>
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<tr>
<td>OR</td>
<td>Odds ratio</td>
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<tr>
<td>RCT</td>
<td>Randomised controlled trial</td>
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<td>SMA</td>
<td>Sports Medicine Australia</td>
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<td>SMIS</td>
<td>The Sports Medicine Injury Surveillance project</td>
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<tr>
<td>Sportsafe Australia</td>
<td>A national initiative from 1998-2000, to progress sports safety established by the Commonwealth Department of Health and Aged Care and the Australian Sports Commission.</td>
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<td>SRV</td>
<td>Sport and Recreation Victoria</td>
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<td>VFL</td>
<td>Victorian Football League</td>
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<td>VicHealth</td>
<td>Victorian Health Promotion Foundation</td>
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<td>WASIS</td>
<td>The Western Australian Sports Injury Study</td>
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Executive summary

Injury prevention and control was recognised as one of Australia’s six national health priority areas in 1994. Sports injuries are one of the particular contexts recommended for the targeting of prevention and control strategies. Since the mid to late 1990’s, sports injuries have increasingly been recognised as a significant public health issue and one that needs a strong preventive approach. Accordingly, sports injury prevention has become an issue of concern to many Government agencies. Since the early 1990’s, there has been increasing attention given to the problem of sports injuries in Australia. Such injuries occur across a range of participation settings including formal sport, informal sport, school sport, active recreation, fitness activities and general physical activity. Sports injuries have now been clearly identified as a public health priority in Australia, though limitations of the available data have been well documented.


This report provides an overview of the sports injury prevention initiatives that have occurred in Australia since the release of the National Sports Safety Framework. It focuses only on research into sports injuries and their prevention published since 1997, on the premise that earlier work informed the development of the National Sports Safety Framework. The focus is on broad-based community-level participation in sport in either formal (i.e. organised sport) or informal (i.e. social sport) settings as this context is where the major public health burden of sports injuries, and the vast amount of participation, occurs. This report brings together the findings of recent published research and other information on injuries sustained by non-elite participants in sport activity and the evidence for measures introduced to prevent or minimise injuries in this context.

As the focus is only on information that is directly related, or potentially related, to sports injury prevention or an understanding of the mechanisms of injury to inform the development of prevention strategies, projects related to the treatment or management of sports injuries have not been included in this report. Similarly, information relating to recreational and water safety (for example, surf life saving or diving) or playground falls have also been excluded as these are related to the water safety or child fall prevention strategies, rather than prevention in the context of organised sport.

There has been no federally funded national lead agency in Australia to guide sports safety policy and to consider provision of infrastructure. This means that there is no national group with the authority or representativeness to enable sustained action at this level. Many of the efforts to guide or direct sports primary prevention actions at the grass
roots level of sports participation have largely come from, or been coordinated by, the health sector. The Australian Sports Commission (ASC) (through the Australian Institute of Sport’s Sports Science and Sports Medicine departments) has made a significant contribution to understanding and addressing sports injury prevention and treatment issues at the higher and more competitive levels of participation through its support for the SportSafe program and funding of research projects. National sporting organisations (through funding from the ASC) and national/state/territory departments of sport and recreation recognise and play a key role in addressing sport safety issues. Partnerships between health and sport agencies have shown that they are a successful means of addressing some sports safety issues. Some states have developed infrastructure to support local level sports safety initiatives, and some research activities, but a full impact assessment of these schemes has not been undertaken.

Dissemination of injury prevention information and other health education strategies has become a popular strategy in Australia. There is no doubt that health and safety education is important. However, the effectiveness of sports-related injury prevention education strategies, either alone or in conjunction with other activities, in this country is largely unknown. The Smartplay message, delivered through the Sports Medicine Australia (SMA) networks, has been adopted by most States and territories and appears to have some brand recognition.

A key factor in prioritising injury areas is the existence or identification of key injury indicators. Such indicators are needed to demonstrate that policy and other changes have actually led to changes in health status over time. The sports injury area is seriously hindered in this aspect, as the quality of the data sources leading to key indicators is very poor. The major injury surveillance initiative since 1997 has been the establishment of the Australian Sports Injury Data Working Party to draw up guidelines for sports injury surveillance. This work has resulted in the release of a working data dictionary. The data dictionary has helped to inform coding schemes for ICD-10 AM and assisted with a number of other surveillance projects. However, its value beyond these contexts is unknown.

At present, there is little incentive to collect sports injury information and no specific body has the responsibility for doing so, or for coordinating such activity. This adversely affects both the quality of the data collected and its analysis. The large number of local level projects with their own data collection forms and unstandardised methodologies compounds the problem. Limited time data collection exercises are being promoted as injury surveillance activities but they rarely include an ongoing monitoring and recording function. It is laudable that sports bodies and community groups now see the collection of sports injury data as an important activity (and this is a major change since 1997) but ad-hoc data collections add little to our knowledge about sports injuries, except for at the local level. There is currently no lead agency to oversee or guide the future development of an Australia-wide approach to sports injury surveillance. Until such a body is established, injury surveillance activities in this country are likely to remain ad-hoc.

It is not possible with the current available data, to compare sports injury rates across different States or other regions of Australia, nor is
it generally possible to compare injury risk across sports. This limits the ability to rank sporting activities for priority setting. Furthermore, there is no baseline against which injury prevention gains can be monitored.

The Western Australian Sports Injury Study (WASIS) is the first prospective cohort study of sports participants in Australia and has demonstrated a gradation of injury risk from highest in Australian football to lowest in netball (field hockey and basketball have intermediary rates of injury). Different patterns of injury, in terms of body region and nature of injury distributions, are evident when data from different sources are combined. Data collected in hospital settings corresponds to more severe injuries than that collected through general population surveys. Generally, soft tissue injuries such as sprains and strains are the most common, as are injuries to the lower limb. Sports injury risk appears to be higher in males and younger persons. This is likely to be related to participation levels and the types of activities that males undertake (for example, competitive football) compared to females.

Epidemiological studies have started to provide evidence for potential sports injury risk factors. The WASIS has provided the best information about risk factors for sports injury in community participants of four sports. Identified risk factors included previous injury, particularly a back injury, and certain psychological profiles. Protective factors were being adequately prepared for the game by participating in formal training, having experience in a sport, being generally healthy and having high physical endurance. Injury history is consistently identified as an injury risk factor, suggesting that poor/inadequate rehabilitation or injury susceptibility (for reasons unknown) need to be addressed. It has been suggested that lower limb injuries, particularly in elite football, are related to ground conditions and surfaces or the pace of the game. However, specific examination of these factors in community-level sport has yet to be undertaken. There is a need to combine epidemiological, biomechanical and medical approaches to take sports injury prevention forward.

The available estimates of the costs of sports injury are only, at best, very general indicators of the size of the problem. The figures are not comparable because of the different factors they consider and the different costs they include and exclude. They are not accurate because of the limitations of the existing data sources used to derive the figures but they do nevertheless indicate the size of the problem and the potential cost benefits to be gained from reducing it. Egger's 1990 estimate remains the only available figure for the cost of sports injuries in Australia. The lack of a more accurate and up-to-date estimate of the cost of sports injuries hampers efforts to determine cost-benefit ratios for the introduction of sports injury prevention measures. Furthermore, it limits the leverage that can be applied to government and other organisations to address the significant sports injury problem in this country. The recognition of longer-term injury effects has implications for both injury prevention and promoting physical activity.

There have been very few studies evaluating sports injury countermeasures both nationally and internationally. This is one of the major gaps in sports injury knowledge currently. This lack of information seriously limits the provision of evidence-based injury
prevention guidelines for sports bodies, participants and parents. Considerable effort will need to be given towards addressing this major information gap if significant gains in sports injury prevention are to be reached over the next decade. International studies are beginning to provide strong evidence for the effectiveness of ankle supports and balance board training for preventing ankle injuries. Protective equipment is a popular strategy but its effectiveness has largely not been demonstrated in the field. Some major trials of the effectiveness of protective equipment are currently in progress in Australia.

Sport safety plans at the sports club, organisation and facility level have received attention over the past five years. There is also quite a considerable amount of descriptive information, with recommendations on personnel, training and education for several sports at this level. Sporting clubs in Australia vary considerably in the extent to which they consider or implement risk management policies, even in the few sports in which this has been formally investigated. Furthermore, the proportion of clubs applying risk management policies, as compared to emergency action policies or head injury management policies, is low. Various barriers to the development, implementation and monitoring of these plans have been expressed. The collaborative, volunteer nature of sports clubs management has several associated barriers to risk management policies in these clubs. The issue of volunteers is even more of a problem in rural areas. Many clubs also lacked the knowledge and abilities to be able to perform the duties that a risk management policy would demand. Committees and personnel have designated roles in a specific sporting organisation, and at most clubs no personnel is assigned to the duties of 'risk management'.

The use of, and factors relating to the use of protective equipment in most Australian sports is not known. Furthermore, whether the equipment being used in sports is suitably protective, fits accordingly, and maintained properly is largely unknown. Before efforts to promote protective eyewear, for example, can be effectively developed, it is important to determine players' current behaviours, knowledge and attitudes associated with protective equipment and injury risk. Negative attitudes and beliefs towards the use of protective equipment need to be addressed.

In summary, this Report provides an update of sports safety initiatives that have been conducted in Australia since the launch of the National Sports Safety Framework in 1997. Because of the recent activities in the sports injury area, we now have a much better understanding of some aspects of sports injury and sports safety than at the time of National Health Goals and Targets Initiative in 1994 and the setting of this national Framework. There are still many aspects of sports safety where our knowledge is still quite limited and other areas where it is practically non-existent. The Table below provides a summary of the current status of sports injury knowledge, as at the end of 2002, and compares this to the
the burden/cost of sports injuries

- some potential risk factors (though this knowledge is still quite limited)

- implementation of interventions

- barriers and motivators associated with the uptake of interventions.

The only area where there is good evidence available is in the description of the nature of sports injuries. There continues to be no evidence about what interventions have been formally trialled, the effectiveness of such interventions or the cost-benefit analyses associated with their implementation.
Injury prevention and control is one of Australia’s six national health priority areas [1, 2]. It was included in the first four identified national health priorities because of the Government’s awareness of the very high cost of injuries from all causes to both individuals and the wider community. It was also recognised that many injuries are preventable or controllable.

Injuries are a leading cause of death, illness and disability in Australia. In 1998, injuries resulted in 7,946 deaths and over 403,000 admissions to hospital [2]. Such injuries are associated with a significant cost to the Australian community. The direct health system costs of injuries in 1993-94 were estimated to be $2,601 million. Total costs were estimated to be more than $13 billion per year [3]. Sports injuries have been identified as one of the important contexts for injury prevention activities [3-5].

Administrative arrangements to tackle general injury prevention have been paralleled, to a certain extent, by those with a particular focus on the prevention of injuries in sport. The relevant peak body until 1998 was the Australian Sports Injury Prevention Taskforce (ASIPT), jointly established in 1995 by the Minister for Human Services and Health and the Minister for Sport, Territories, and the Environment. In conjunction with the Australian Sports Commission and the Commonwealth Department of Health and Aged Care, ASIPT developed a national sports safety framework to assist it in meeting these goals. This framework, SportSafe Australia: A National Sports Safety Framework was released in December 1997 [6].

Historically, advances in sports medicine have largely governed the sports injury domain. As such, the focus has been on improved diagnosis, treatment and rehabilitation of injuries. Since the mid to late 1990s, there has been a paradigm shift with sports injuries increasingly being recognised as a significant public health issue and one that needs a strong preventive approach. Accordingly, sports injury prevention has become an issue of concern to many Government agencies.

Sports injuries occur across a range of participation settings including formal sport, informal sport, school sport, active recreation, fitness activities and general physical activity. Sports injuries have now been clearly identified as a public health priority in Australia [1-6], though limitations of the available data have been well documented.

More recently, sports injury prevention has been the cornerstone of other national public health frameworks [6, 7]. The Active Australia framework stressed that participation in sport activities is important for public health because it maintains general good health, provides stress relief and prevents many chronic non-communicable diseases.
However, increased participation in sport increases exposure to the risks associated with sports injuries. The National Sports Safety Framework [6] linked with Active Australia [7, 8] and, in doing so, provided guidance on preventing sports injuries. The National Sports Safety Framework recognised that sports injuries are a cost burden on both individuals and society with respect to the duration/nature of treatment, the amount of sport/working time lost, permanent damage/disability, reduced quality of life and other monetary costs [6]. Their prevention must be a major public health goal [1-6].

As a direct outcome of the national injury prevention/control strategies, and successful discussions between the then Commonwealth Department of Human Services and Health and the Australian Sports Commission, a collaborative partnership between these two government sectors was formed. In 1995, the Minister for Human Services and Health and the Minister for Environment, Sport and Territories established ASIPT to promote a national perspective on sports injury prevention. Since then, significant progress has been made towards sports injury prevention at a national, state and local level in Australia.

Subsequent to the release of the National Sports Safety Framework, the Australian Sports Commission and the Commonwealth Department of Health and Aged Care established SportSafe Australia, a national initiative to progress sports safety, including the development of resources and educational materials. SportSafe Australia represented a strong partnership between the Health and Sport sectors, with some funding from the Federal Australian Government. For the first two years, this service was performed “in-house” at the Australian Sports Commission. It was then outsourced to Sports Medicine Australia for the next two years. Since this initiative finished in 2000, there has been little further significant national progress in sports injury prevention.

The National Sports Safety Framework was firmly linked to strategies to promote physical activity for the health of all Australians [6]. In doing so, it recognised that strategies to promote safe physical activity to reduce the incidence of non-communicable diseases will only be effective if they have a foundation built on good safety principles. Future physical activity and safety promotion activities will need to continue to build a strong evidence-base for sports safety initiatives throughout the country. This Framework also acknowledged that because of the wide range of individuals and organisations involved in sport, strategies for reducing sports injuries would need to be collaborative. Strategies had to be developed and implemented with the support and participation of as many groups as possible, and the successes and weaknesses of any initiatives introduced should be monitored. A collaborative approach was also necessary to ensure that suggested injury countermeasures were acceptable to those whom they are designed to protect. If not, there would be little chance of their widespread adoption.

The major barriers to sports injury prevention, as identified in the National Sports Safety Framework, in 1997 were [6]:

- a lack of data on the incidence of, and causal factors for, sports injuries
- the wide range of organisations and individuals involved in sport and the consequent difficulties of alerting them to, and involving them in, strategies for injury reduction
- a reluctance to change on the part of sports organisations, which could inhibit the introduction of changes designed to reduce injuries
- little or no evidence base for the effectiveness of existing injury prevention measures.

The aim of this Report is to provide an overview of the sports injury prevention initiatives that have occurred in Australia since the release of the National Sports Safety Framework in December 1997. It focuses only on research into sports injuries and their prevention published since 1997, on the premise that earlier work informed the development of the National Sports Safety Framework. The focus is on broad-based community-level participation in sport in either formal (i.e. organised sport) or informal (i.e. social sport) settings as this context is where the major public health burden of sports injuries, and the vast amount of participation, occurs.
1.1 Scope and content of the report

This report brings together the findings of recent published research and other information on injuries sustained by non-elite participants in sport activity and the evidence for measures introduced to prevent or minimise injuries in this context. Elite level participation is taken to represent high-level competitive and performance-based participation (i.e. international, national or state-level). As this report is concerned with broad community-level sport participation, information relating to elite athletes has been largely omitted. However, some research in this area is documented in Appendix 1 which is a bibliography of Australian sports injury research during 1998-2002 if it was contributed during the consultation process (described in 1.2).

As the focus of this report is only on information that is directly related, or potentially related, to sports injury prevention or an understanding of the mechanisms of injury to inform the development of prevention strategies, projects related to the treatment or management of sports injuries have also not been included in this report. Similarly, information relating to recreational beach and water safety (for example, surf life saving or diving) or playground falls have also been excluded as these are related to the water safety or child fall prevention strategies, rather than prevention in the context of organised sport.

Effective prevention of sports injuries requires a substantial information base. The most important sports injury information requirements are:

- documentation of policy and health promotion initiatives
- routine injury surveillance, including a monitoring function (for example, incidence rates, secular trends, regional comparisons, etc.)
- an understanding of the causes of sports injury (for example, risk factors, protective factors, causal mechanisms, etc.)
- an evidence base for the effectiveness or otherwise of preventive initiatives (for example, lab based testing; field based implementation trials)
- research findings translated to health promotion initiatives to inform participants and sports organisations about injury risk and effective countermeasures.
- knowledge about, and understanding of, injury risk and safety behaviours in both participants and those responsible for delivering sport
- motivators for, and barriers against safety behaviour change.

No single data source is able to serve all of these purposes because they each require a different emphasis and different attributes. The following chapters discuss the progress made in each of these areas since 1997 and summarises the current level of knowledge in Australia. The Report begins with an overview of key policy and health promotion initiatives in Australia since 1997. Structural issues relating to injury surveillance are summarised and an update on knowledge of the incidence of sports injuries in this country is given. Consideration of the evidence for various risk factors for sports injuries is given before injury prevention measures are discussed. The development of injury risk management plans, as a particular injury prevention measure in the sporting context is discussed. Finally, the barriers towards adopting safety behaviours and safety measures are overviewed.
1.2 Information sources used

In collating information for this Report, a number of sources were used. An extensive literature search and information gathering process was adopted to identify information for including in this review. This review also drew heavily on an earlier report prepared for the Commonwealth Department of Health and Ageing by SMA.

Formal literature searches through CD-ROM databases and other library services to identify sports injury research published since 1997 was performed. Databases searched included PubMed, Medline, Cinahl, PsychLit, and Sport Discus. The key words 'injury' and 'Australia' were searched in both the abstract and author affiliations of all papers recorded in these databases during 1998 and 2000.

Links were also made with a number of formal and informal networks. An emailed request was widely circulated across the country to the following networks to reach as wide an audience as possible and to request information for documenting in this report:

- The State Injury Prevention Groups, through the Commonwealth Department of Health and Ageing
- The State Departments of Sport and Recreation
- The Australian Sports Commission
- The Australian Injury Prevention Network (AIPN) email list
- The Sports Injury email list (an international email list maintained by the University of Otago)
- The NSW SafeComm listserv
- The Victorian Safe Communities Network Inc listserv
- Sports Medicine Australia branches
- Sports injury experts personally known by the consultant.

Appendix 2 lists the organisations and individuals that responded to the request for information for this report.

It is acknowledged that the material identified through this approach and referenced in this report may not be fully inclusive of all recent and current activities in Australia. However, it represents the information provided by those who responded to the email requests for information (supplemented by the formal literature searches).

In addition to the information included in the body of this report, this consultation process also sought details on current and recent sports injury initiatives across the country, including funded activities and student research projects. This detailed information is provided in appendices to the main report. Appendix 1 is a bibliography of published Australian research and other initiatives and includes listings according to sport and other categories of interest. Appendix 3 is a summary of sports safety activities across the country during 1998-2002. It also highlights the range of agencies involved in funding this important area.

Contributors to this Report provided this information.

Finally, an important aspect of injury prevention activity is capacity building and enhancement of the workforce. In the sports injury area, a significant amount of effort over the past four years has been applied to the training of qualified researchers and other personnel. This has been done through various university PhD and other postgraduate programs, as well as Honours programs. Appendix 4 therefore gives a list of current and past student research projects in the sports injury area. It is particularly pleasing to note that a number of students who have undertaken sports injury projects for their Honours work have since elected to undertake further postgraduate research in the area. The university of enrolment and the source of any scholarship, when applicable, are also indicated. Hopefully, this will be able to be harnessed to further increase capacity and real sports injury prevention gains in Australia.

A series of detailed reports describing injury prevention measures for 21 specific sports have been published in Victoria. These reports are listed in Appendix 5.
Chapter 2

Broad sports safety policy developments since 1997

The Australian Sports Injury Prevention Taskforce (ASIPT) was established by the then Commonwealth Department of Human Services and Health and the Australian Sports Commission in 1995 as an advisory and coordinating body and continued its activities until 1998. In 1997, it released the National Sports Safety Framework [6]. It was never intended that ASIPT would have a long existence; rather its role was to provide a foundation for the future direction of sports injury prevention in Australia. In 1998, the Commonwealth Department of Health and Family Services reiterated its commitment to sports safety in its updated policy document: National Health Priority Areas - Injury Prevention and Control [2]. Subsequently, the Australian Sports Commission and the Commonwealth Department of Health and Aged Care established Sportsafe Australia to progress sports safety at the national level in Australia through the development of resources and educational materials. The aim of Sportsafe Australia was to represent a strong partnership between the Health and Sport sectors, with a funding base from the Federal Government. For its first two years, it was located as a program of the Participation Division of the Australian Sports Commission (ASC) (which was also responsible for Active Australia policy). In the later two years, the ASC outsourced this work to Sports Medicine Australia.

Whilst ASIPT and Sportsafe Australia were in a position to recommend strategies and initiatives for reducing injury, its role was only as an advisory body. Instead, they had to rely on education and persuasion, which were sometimes slow in producing results given that so many different organisations were involved. A lack of infrastructure support for sports safety action and ownership of the problem, both at the local and lead agency levels, were also issues. Sportsafe Australia was funded until the end of 2000 and there has been no national sports safety initiative since then.

The Federal Health Department took leadership in other areas too. In 1997, the Commonwealth Department of Health and Aged Care established the National Injury Prevention Advisory Council (NIPAC) to provide advice on how to meet the injury prevention goals set out in the National Health Goals and Targets. This committee produced a number of reports outlining future research needs and successful injury prevention outcomes in 1999 [3, 4]. The NIPAC's assessment of the status of sports injury prevention evidence [3] as at 1999 is shown in Table 1. A further addition to this table could be evidence to guide countermeasure implementation such as identifying barriers and motivators for sports safety actions. In 1999, the status of knowledge of that area would also have been rated as “evidence not available”.

...
The NIPAC conclusions mirror those of a National Health and Medical Research Council (NHMRC) Strategic Development and Research Committee that also reported in 1999. The NHMRC report was aimed at strategically changing the direction and emphasis of injury prevention research efforts and their underlying infrastructure [5]. The status of sports and recreation injury prevention in Australia at that time was summarised by the NHMRC as [5]:

- the problem is not clearly identified in routine mortality and morbidity collections but has been clearly demonstrated in a number of studies;
- aetiology of injury is poorly understood, except in elite athletes;
- risk of injury is poorly understood;
- sports injuries occur across a range of settings;
- surveillance data does not adequately identify the sequence of causes leading to injury and exposure data is fragmented, especially for children;
- the cost of sports injuries cannot be clearly identified.

Table 1: **Summary table of available evidence on sport and leisure injuries**

(Source: National Injury Prevention Advisory Council, 1999)

<table>
<thead>
<tr>
<th></th>
<th>Incidence</th>
<th>Burden/cost</th>
<th>Nature of injuries</th>
<th>Identification of risk factors</th>
<th>Identification of solutions</th>
<th>Interventions trialled</th>
<th>Evidence of effectiveness</th>
<th>Cost benefit analysis</th>
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Key:  
+ evidence available;  
– evidence not available; and  
+/- evidence limited in some areas.

Later chapters of this report summarise advances in knowledge in Australia since 1997 but the current status is still much the same as it was summarised in 1999.

Sports injury prevention has also been the focus of attention of State Government agencies. The New South Wales Government established a body specifically for the compensation of serious sports injuries: the New South Wales Sporting Injuries Insurance Scheme. This is a successful, non-compulsory, non-profit government insurer for sports participants sustaining catastrophic sports injuries involving more than 35% permanent loss of a body part. The Scheme is cost-neutral and provides an incentive to actively prevent injury through promotion of safe sport practices and funding of injury prevention research. The NSW Sporting Injuries Committee, through the scheme, funds a range of sports injury activities in NSW, including research, injury surveillance, health education/promotion and capacity building initiatives.

A limitation of the NSW Scheme is that it is not compulsory for all sports. Furthermore, an assessment of the impact of the Scheme on sports injury rates across the State has not been undertaken, partly because of the lack of complete coverage. Anecdotal evidence would suggest, however, that it has impacted in some areas. Orchard and Finch, in a recent Medical Journal of Australia article [9], argue that a national approach to sports safety, particularly the provision of infrastructure and funding to support such activities is urgently needed in this country and that the New South Wales Sporting Injuries Committee approach is one potential model for this.

In Victoria, the Victorian Health Promotion Foundation (VicHealth) has established a program of funding aimed at local club access to sports safety equipment. Under the funding scheme, eligible local sporting organisations can apply for funds to purchase Australian standards approved, or parent sporting body, improved equipment to enhance safety at the local level. VicHealth’s ongoing investment in this funding program reflects its belief that this is an investment in good health. However, this program has not been fully evaluated for its ongoing impact on safety policies and practices at the club level.
2.1 Summary of current status

There is currently no national lead agency in Australia to guide sports safety policy and to consider provision of infrastructure. This means that there is no representative national group with the authority to lobby for sustained action at this level.

Many of the efforts to guide or direct sports primary prevention actions at the grass roots level of sports participation have largely come from, or been coordinated by, the health sector. The ASC (through the Australian Institute of Sport’s Sports Science and Sports Medicine departments) has made a significant contribution to understanding and addressing sports injury prevention and treatment issues at the higher and more competitive levels of participation through its support for the SportSafe program and funding of research projects. National sporting organisations (through funding from the ASC) and national/ state/ territory departments of sport and recreation recognise and play a key role in addressing sports safety issues. Partnerships between health and sport agencies, such as that behind ASIPT and the tripartite group behind the Victorian Smartplay Program, have shown that partnerships are a successful means of addressing some sports safety issues. Where SMA state agencies have linked with sport organisations and state governments (for example, as in South Australia and Victoria) very good outcomes have been achieved.

Some States have developed infrastructure to support local level sports safety initiatives, and research activities, but a full impact assessment of these schemes has not been undertaken.
Chapter 3

Health education activities in Australia, 1997-2002

Since the mid-to-late 1990s, sports injury health promotion activities (largely with a health education focus) have operated at the state level across Australia. These include the Smartplay program in South Australia and Victoria, Safesports in New South Wales, SportSafe in Western Australia and others. Sports Medicine Australia (SMA) is a major contributor to health promotion activities across the country, and supplements the activities already undertaken by state health and sport and recreation departments. More recently, the Smartplay program has been disseminated through the state and national offices of SMA across the country.

The health promotion approach to sports injuries is relatively new in Australia. Nonetheless, this has become a major activity in recent times. The SMA has taken the leadership in this area through its extensive network into each state and territory of Australia. In 1997, the South Australian SMA branch developed a “Smartplay” health message “Warm-up, Drink-up, Gear-up” and logo aimed primarily at adolescents and young adults. The Victorian State Government has since adopted this health message, after further market testing in 1999. The Smartplay message, logo and accompanying resources, is targeted at all sports participants and has been adopted in most other State and Territories. For example, the Victorian Department of Health, Sport and Recreation Victoria (SRV) and VicHealth have established a tripartite body called the Victorian Smartplay Program, which delivers these resources through the Victorian branch of SMA. However, there has been no formal evaluation of this health promotion strategy so information about its community reach and uptake, impact on safety practices and cost effectiveness is not known.

SMA has delivered the Safer Sport Program throughout Australia for many years. This program is aimed at the broad community level of sport and claims to educate its participants about the primary, secondary and tertiary prevention of sports injuries. It is a unique program, which has made some small inroads into structural and policy change in sport. Participants of the full program are accredited as sports trainers to assist with the initial injury management and referral for medical treatment on the sports field.

In 1998, a booklet entitled “How to become a SportSafe club” was jointly published by SMA and the ASC under the ASIPT partnership [10]. The aim of this booklet was to assist local sporting clubs with the development of a sports safety plan as recommended by ASIPT [6]. This booklet has been widely disseminated and used as the basis of sports safety training sessions of sporting clubs applying for...
funding through the VicHealth Sports Safety Equipment Grants Scheme. However, whether or not this booklet has led to direct improvements at sporting clubs is unknown.

In response to earlier input from a range of sports bodies, SRV commissioned a series of 21 sport specific injury countermeasure reviews (Appendix 5). These were all prepared as detailed scientific review reports. However, SRV and its sports bodies also translated these reports into plain language sports safety fact sheets that have since been disseminated widely to community level sports people. Recently, a number of these fact sheets have been reproduced under the Smartplay logo as one of the program resources.

Education is a strategy that is often advocated for injury prevention. For example, a survey of teenagers aged 14-16 measured knowledge of basic injury management – specifically the RICER/NO HARM acronym [11]. The authors concluded that education programs were needed to ensure that adolescents were familiar with the RICER first aid steps. A later survey of state-level netball players, found that reported injuries were inconsistent with wide adoption of injury prevention behaviours [12]. Once again, the authors advocated wider dissemination of injury prevention information to all players.

A limitation of education strategies, which has unfortunately not always been recognised by its advocates, is the provision of information alone is unlikely to lead to behaviour change or institutionalisation of preventive efforts. This has been recognised by the Victorian Smartplay Program, which includes education strategies as only one of its activities. Statement of this limitation is not to downplay education’s vital role however, future education activities across Australia will need to be integrated into broader, multifaceted programs.

Another limitation is that the various education strategies have rarely been evaluated. This means that their effectiveness, either alone or in conjunction with other efforts, is not known. Just because a high quality resource is produced and disseminated, this does not necessarily mean that it will have any impact on subsequent safety behaviours. Although the Smartplay message underwent extensive market testing in both South Australian and Victoria before it was implemented, its impact has not been formally evaluated since.

3.1 Summary of current status

Dissemination of injury prevention information and other health education strategies has become a popular strategy in Australia. There is no doubt that health and safety education is important. However, its effectiveness as an injury prevention measure, either alone or in conjunction with other activities, in this country is unknown.

The Smartplay message, delivered through the SMA networks, has been adopted by most states and territories and appears to have some brand recognition.
Although injuries sustained during sport and physical activity have been identified as a major public health concern in Australia and are regarded as a major barrier to participation few data are currently available to quantify the magnitude of the problem [3]. Most of the Australian sports injury prevention research to date relates to elite/professional athletes or to particular subgroups of competitive participants and few sports. However, on a frequency basis, the vast majority of sports injuries occur to community sport and other physical activity participants. Data relating to elite/professional athletes may not be applicable to community level sport and physical activity because the injury risk factors and injury profiles are different. Nevertheless, the current knowledge base suggests that most injuries are likely to be preventable. Research is needed to extend current knowledge so that evidence-based strategies to prevent sport and physical activity injuries can be developed. Such an evidence base will provide a significant underpinning for the promotion of safer, lifelong participation in sport and physical activity by all Australians.

This Chapter describes Australian initiatives and other activities in the broad area of sports injury surveillance since 1997. It describes recent developments in injury surveillance in Australia and outlines the status of these developments. Data obtained from these studies is presented in Chapter 5.

The latter half of the 1990s saw an increase in the amount of injury surveillance activities and epidemiological research undertaken into sports injuries in Australia. This has been accompanied by an increasing awareness of the need to conduct research into injuries that occur to community-level participants, rather than just elite athletes, as this group represents by far the large participant base and injury frequency.

Despite this increased attention, data on sports injuries in Australia is still limited, with no regular standardised collections of data in general use. The main sources of routinely collected population-based injury data continue to be general data collections such as those relating to hospital admissions, emergency department presentations and coronial records. However, together these sources only have the potential to describe fewer than 30% of all sports injuries as they only represent the most serious cases that have resulted in death or hospitalisation [13].

To date, there has been a lack of prospective data describing the true incidence of sports injuries in Australia. Much of the existing research has been purely descriptive and based on case-series reports from emergency departments [13-15], general practice clinics [13, 16], sports medicine clinics [17-19] or medical coverage services at sporting events.
Other studies have focused on elite or professional participants in a small number of sports [21-23]. The data from these studies is unlikely to be representative of all sports injuries; neither do they generally represent well-defined cohorts of participants. A population based household survey in the Latrobe Valley, Victoria has provided the first truly population based estimates of the rate of medically treated injuries [13]. A prospective cohort methodology, utilising monthly telephone surveys, has been able to define injury risk in general sports participants in Australia, for the first time [24, 25].

The value of many previous sports injury studies has also been hampered by a lack of exposure-adjusted incidence rates, an essential factor in the calculation of incidence levels and the comparison of rates across different sports [26]. Those that report exposure-adjusted rates have generally focused on professional athletes and have neglected to record exposures associated with participation in training. This is limiting because the reporting of only time spent during games can lead to the reporting of inflated injury rates. The different methods used to calculate exposure time further compounds the comparison of discrepant findings across studies.

The general problems associated with sports injury data have been well documented [3, 6, 27, 28]. Despite this clear identification of issues in 1995, they still prevail and include:

- **No central data collection or collation agency.**
- **A lack of standardised definitions and data collection methodologies.** This is an international problem. The failure to develop and adopt universal definitions has resulted in inconsistencies in the data collected and reduced the possibility of meaningful comparisons between collections (such as between sports and jurisdictions). Methodologies that are reproducible, reliable and standardised are required.
- **A lack of data on injury trends over time** to ascertain whether injury trends are increasing or decreasing or being influenced by injury prevention initiatives.
- **A lack of data about the factors associated with injury occurrence** - this limits the data’s ability to inform countermeasure development and implementation. If the causal factors of injuries are not known, it is not possible to identify appropriate injury prevention measures.
- **Underestimation of the total number of injuries sustained and overestimates of severity.** Current data collections tend to overstate the severity of sports injuries. Treatment in hospital settings, where the most reliable information is available, is usually only for severe, acute injuries with a need for prompt or urgent care. People with injuries not needing acute attention may go to other places for treatment, such as a general practice clinic, with subsequent referral to a surgeon at a later stage, if necessary. Others may choose not to receive any medical attention at all and so their injuries will be unrecorded in treatment databases. The extent of this under recording is difficult to gauge. Acute injuries receive more attention than chronic injuries in injury data collections based in hospital settings. On the other hand, data collected in sports medicine clinics tend to over represent overuse injuries. However, both types of injury are costly to the individual and to the health system.
- **A heavy reliance on self-reported data.** Many injury data collections have relied on collection of data through self-report surveys. Such data collections are subject to recall bias and subjectivity on the part of participants and are unlikely to provide reliable and valid injury details.
- **Poor data capture.** Many data collections are incomplete because of inconsistencies in the information collected or a lack of commitment or training on the part of those responsible for collecting, collating, publishing or analyzing the data. For example, some local-based projects have poor response rates because there is no imperative for groups to collect sports injury statistics. Unfortunately, the capture rate is not often reported so an estimate of this magnitude and frequency of this type of bias is not possible.
- **Timeliness.** A number of data reports are produced well after collection of the data, limiting their relevance and usefulness. Timeliness is particularly needed if data is to inform prevention strategies on a proactive basis.

Initiatives to improve data collections (and to enhance injury prevention measures) have received increasing prominence and support in recent years following wider appreciation of the public health and other costs of sports injuries and the inclusion of injury prevention within the Commonwealth’s National Health Goals and Targets.
4.1 The Australian sports injury data dictionary

There is general agreement about the inadequacy of existing data collections on sports injury and the need to improve them. It is also well recognised that comprehensive, consistent, timely and accurate data are an essential prerequisite for improved injury prevention approaches. Such information can be used to identify priority areas for injury prevention, to evaluate the effectiveness of injury prevention measures and to inform educational and training programs on injury prevention.

Largely driven by the ASIPT, significant efforts were made to establish national sports injury surveillance guidelines in the late 1990s. The Australian Sports Injury Data Working Party was established by ASIPT to oversee the development of guidelines for injury data collection and classification for the prevention and control of injury in sport and recreation, named the Australian Sports Injury Data Dictionary (ASIDD) [29]. These guidelines were released as a working draft document towards the end of 1998 and are currently available as a pull-down document on the SMA website (www.sma.org.au).

The aim of the Australian Sports Injury Data Dictionary (ASIDD) was to overcome some of the problems associated with existing data collections on sports participation and injury discussed above. Its major contribution has been to develop a standard data collection coding scheme and to provide simple to use data forms, based on the one developed by Finch et al [30]. It was hoped that the existence of the ASIDD would ensure consistency and comparability in the data collected in the future, irrespective of its source.

Since its release in 1998, subsequent development has halted. ASIDD was not evaluated though there have been some scale sub-studies uses of the data by researchers. A formal evaluation and further development is required before it can be stated categorically that this will greatly improve the situation (though it has the clear potential to do so). Some further development of the ASIDD is also necessary, most notably on agreed definitions of sports injury and severity of injury.

Unfortunately, the extent to which the ASIDD guidelines have been used or accessed from the SMA website (or previously the ASC website) has not been monitored. Anecdotally, they have been referred to and used by a number of community and research groups, but it is not possible to quantify the extent to which this has occurred. Furthermore, the relevance and direct applicability of these injury surveillance guidelines in the sporting field has not been assessed and this is a necessary step before they could be formally adopted across the sports injury domain.

Notwithstanding this, some of the data items – notably those relating to the nature of the sporting activity and external cause of injury have been used to help inform the development of data coding systems at both the national (for example, sporting activities for the ICD-10 AM) and the international external cause of injury codes (James Harrison, personal communication). The ASIDD has also been used in New Zealand to develop a questionnaire for a survey of national sports organisations on sports injury surveillance systems (David Chalmers, personal communication). It was also used to assist the New Zealand Health Information Service to compile a list of sports for inclusion in the Australian revision of ICD-10.

The ASIDD in its current form does not provide guidance on monitoring exposure to injury, since it does not record hours of player participation. However, if widely adopted the ASIDD will greatly improve information on sports injury, especially at the club and team level, thus enhancing efforts to reduce the incidence and severity of injuries sustained in sport.
4.2 An update of major sources of sports injury data

4.2.1 Hospital data collections

While hospital data collections are useful for describing case types, they typically cannot be used to measure rates or trends because of the lack of appropriate denominator data. Nor can such data provide quantitative estimates to compare different sports or particular subsets of the population. Such data collections generally do not correspond to well-defined populations or groups of sports participants. While development of a system with this capacity is technically feasible, the cost is generally considered prohibitive.

Each State and Territory maintains a central database of hospital admissions and hospital emergency department presentations, though the level of specificity of the injury details may differ across jurisdictions. Hospital records provide details of every patient admitted and they are therefore an important source of information on severe and acute injuries.

The usefulness of hospital admissions data for severe sports injury has been limited because of the system used to code injuries and identify sports injuries. The external cause of injury coding under International Classification of Diseases ICD-9, E800-999 was limited in respect of sports injuries, as it did not allow for identification of specific sports. An updated classification schema (ICD-10 AM) has been used by all States and Territories since July 1999. This updated classification codes to a high level of detail in the range of sports and the place of occurrence. However, it is not currently known to what extent these sports specific codes are being used and if they could usefully monitor sports injury trends. Data coded to the new classification should become available during 2002/2003 and the Centre for Injury Studies at Flinders University has planned an initial examination of the sports injury cases (James Harrison, personal communication).

Implementation of the first edition of the ICD-10 AM was not able to specifically identify sports injuries in many jurisdictions because of the lack of specific sports codes. In 2000, the second edition of the ICD-10 AM introduced a sub-division of activity which included the sporting field and identified a limited set of sports codes [31]. The internal validity and the use of these new sports codes is unknown but will also be investigated by Harrison and colleagues in the examination referred to above. The third edition of the ICD-10 AM agreed to adopt a sub-type of sporting activity codes and this has the potential to provide quite detailed information about sports injuries for the first time [31]. Once these codes are adopted, it will allow quite a bit of detail about the severe end of the sports injury spectrum and the costs of such injuries in the hospital setting. This will provide the first comprehensive and national estimates of sports injury incidence in this country. When this data is combined with case-mix and injury severity measures, it will also enable cost indications to be generated. As noted elsewhere in this document, a good estimate of the cost of sports injuries is urgently required to help inform policy decisions in this area.
Another point about the hospital data collections is that the severity of injury is measured in hospital data in terms of threat to life. This is of limited relevance in the case of most sports injury, for which acute and long-term morbidity is more relevant.

The Latrobe Valley sports injury study found that for every injury requiring hospital admission: 10 cases were treated at hospital emergency departments; 12 by general practitioners; 41 by other medical or para-medical staff or volunteers and 145 required or received no treatment [13]. It also showed that together, hospital admissions, hospital emergency department presentations and general practice consultations only accounted for approximately 30% of all cases of sports injury. This shows that the majority of sports injuries are not severe and do not require major utilisation of medical services. The study also emphasised the under-reporting of sports injuries when data from only hospital settings is available.

Hospital emergency department data is not a good source of sports injury data for the generation of useful quantitative measures of sports injury incidence or trends over time. Whilst development of an emergency department data system for sports injuries is technically feasible, the cost of doing this well is prohibitive and the likelihood of capturing all relevant details on the circumstances of injury is low. Nonetheless, such data is useful for cross-sectional studies and for determining the relative proportion of sports activities associated with emergency department presentations.

The national collection of hospital admissions data is quite complete and so provides a good source of general injury data for generating quantitative estimates of the injury burden. However, the issue in the sports injury context is whether this data is reliable or useful enough to identify the classes of injuries of interest. The recent technical review of the National Health Priority Area injury indicators [32] concluded that this data may provide some useful information about trends in sports injuries. However, its capacity to provide good population estimates of injury incidence is currently poor because of coding limitations.

4.2.2 Coronial data

The National Coroners Information System (NCIS) has the potential to provide detailed data on all sports injury deaths in Australia. However, this potential has not been used to date. Coronial records are likely to be limited as a major monitoring tool. Victorian coronial data, for example, shows that very few sudden and unexpected deaths occur through participation in sport and physical recreation activities, with the highest number the result of drowning. An examination of this data has found that there were 25 football-related deaths from all causes in Victoria in the period 1968-1999, 22 in Australian Rules Football and three in rugby union [33].

Coronial records identify injury cases not available through ABS and other sources. They have the capabilities to identify sports injuries, but as sports injury deaths are rare, its contribution to a national picture of sports injuries is likely to be small.
4.2.3 Medical coverage during sporting events

One of the contexts where sports injury data could be collected is through medical coverage of sporting events. With most sporting events, this medical coverage consists of sports first aid providers, doctors and others who are on hand to treat any injuries that occur during the event. It is a medico-legal requirement that injury records are maintained during such events and there is therefore considerable potential for medical coverage services to provide injury data.

A standardised data collection methodology has been developed and trialled for use by medical coverage services at large (multi-) sporting events [30]. A range of sports medicine and sports first aid personnel was involved in the trial and injury details were collected on all persons receiving treatment from the coverage team, irrespective of injury severity. The resultant sports injury data collection form is easy to use, can be used by all types of medical personnel and can provide valuable data in a timely manner. This methodology has since become a standard for use at both Masters Games and University Games events nationally. It has also since been used in other contexts and surveillance activities. It is believed that this form has since been adopted as a standard during medical coverage of other national sporting events but its wider use has not been monitored. Furthermore, whether or not its use has lead to either injury prevention initiatives being implemented or improved surveillance is not known.

The published data collection form subsequently was used as the basis of the generic forms provided in the ASIDD [29]. Although the form was shown to be a usable format for collection of medical coverage data, the authors stressed that it would only be an effective injury surveillance tool if it was incorporated as a core element of medical coverage provision, with appropriate infrastructure to support it [30].

Public health surveillance was conducted during the Sydney 2000 Olympic and Paralympic Games [34]. This was coordinated by NSW Health and was one of the first instances of real-time injury surveillance conducted in Australia. Data was collected both on site and through emergency departments during the duration of the Games. Just over half of the cases of people presenting to a sentinel hospital with a targeted condition were due to injury, though many were probably not due to sports injuries. It is likely, however, that the 12,000 consultations for treatment recorded at the Olympic venue medical facilities were for sports injury related problems.

4.2.4 General practice and sports medicine clinics sources

Information about injuries treated at general practices and sports medicine clinics has the potential to provide valuable data on sports injuries by providing a greater representation of the sports injury problem, across the full spectrum of injury severity. Although there is this potential, the data from such clinics is not widely collated. When the information has been examined or reported, it has generally related only to competitive athletes or is of the form of case reports of treatment/rehabilitation programs.
Data from such settings also have the potential to contribute to our knowledge of less severe injuries as well as the often-serious overuse injuries. Overuse injuries can be quite severe in terms of disablement and time away from sports activity but are treated almost exclusively outside the hospital setting. This potential is largely unrealised at present. The data obtained from general practice and sports medicine clinics is useful for describing case types. However, it is not currently possible to use it for measuring injury rates as it does not consider exposure, nor does it consider non-injured participants.

The Sports Medicine Injury Surveillance (SMIS) project was established to provide a comprehensive description of sports injuries presenting to sports medicine clinics for treatment of a new sports injury. The SMIS project was implemented in five allied sports medicine clinics in metropolitan Melbourne over a 12-month period. A two-sided injury surveillance form was designed to gather the sports injury information. The first side was completed by the person presenting for treatment, or their guardian, and requested information about personal and demographic details, sports participation, injury occurrence, health insurance cover and reasons for attending the clinic. The second side was completed by the attending practitioner and recorded the provisional injury diagnosis, treatment given and initial assessment of injury severity. Once patients had completed their side of the form, they handed it to their sports medicine practitioner who completed the remaining section of the form. Over the 12-month data collection period, 6,911 new sports injury cases attended one of the five sports medicine clinics. The injury surveillance system captured data on 6,476 sports injury patients (or 94% of the total).

As the SMIS project was not conducted within a well-defined region, injury rates (per head of population) could not be computed. The high capture rate associated with the SMIS database indicates that the data collected was very representative of cases presenting to these sports medicine clinics. However, since the patients included in this study were not members of a well-defined cohort, it is not possible to assess how representative this sample is of all sports injury cases in the area serviced by the clinics. This methodology has been published [35] and is available for adoption at other clinics.

The Extended Latrobe Valley Injury Surveillance Project collected data on all injury presentations, including for sport and recreation, to general practitioners in the Latrobe Valley over a 12 month period from November 1994 [13]. This was a particularly useful study because data were also available on sports related injuries in the same population that were treated elsewhere (hospital emergency departments, hospital in patients, etc.) enabling comparisons to be made between injuries treated at these different sources.

Jago and Finch conducted an injury surveillance project in a general practice clinic in metropolitan Melbourne [16]. Patients were identified by the receptionist as being a sports injury case and invited to participate in this study. This methodology has not been applied in other general practice clinics.

Reasons for attending a general practice clinic, rather than a hospital, for treatment of a sports injury have been reported as being “injury not severe enough” (58% of cases), “the clinic being closer to home” (43%) and “a shorter waiting time” (25%) [16]. In regards to sports medicine clinics, patients had both professional and non-professional backgrounds and were not just local suburb residents [17]. The most common reasons for attending a clinic was its location (37%) and referral/recommendation (31%). These reasons need to be taken into account when attempting to extrapolate findings from clinic studies to general injured sports participants as the former may be a biased sample.
4.2.5 Insurance data

Some insurance companies collect information on claims made to them for the costs of treating sports injuries. To date, this information has not been fully exploited for injury prevention purposes in Australia because it is not generally available. Its greatest potential use is in providing information on sports injuries requiring treatment provided outside hospitals, for which there are few other sources. An Honours project undertaken at Deakin University in 1999, examined squash injury insurance claims and found them to be a potential useful source of injury data [36].

4.2.6 Sport specific data collections

The previous data sources are all based on treatment as a capture criterion. They are therefore potentially biased and only have information on case records. The major way to overcome this is to collect data in the sporting context directly by monitoring injuries occurring in defined cohorts of participants, such as teams of players. Some sports organisations collect injury data relating to their sport. Some individual clubs also collect such information. However, these data collections tend to be ad-hoc and the methodologies unstandardised.

The largest continuous sports injury surveillance system in professional sport within Australia relates to Australian football [23]. Since 1992, routine injury surveillance funded by the Australian Football League has been coordinated by the Australian Football League Medical Officers Association (AFLMOA) [23]. No similar continuous data surveillance exists for non-elite Australian football players although a number of short term, one-off studies have been conducted in Victoria [37, 38]. The AFLMOA injury surveillance project provides a good model of how high level sporting bodies can collect useful sports injury data and use it to inform policy and practices [23].

Until very recently, the Australian Football League (AFL) injury surveillance has been the only program of formal injury surveillance in elite sport. A similar injury surveillance scheme has also now been started for elite cricket (John Orchard, personal communication). A three-year injury surveillance project of rugby union injuries at all levels has also recently commenced in NSW. It is being conducted by researchers at the University of New South Wales and will facilitate comparisons of injuries between elite and non-elite players of that sport. The project has adapted the methods developed by the AFLMOA for elite Australian football. Netball Australia has also been conducting injury surveillance activities with its elite squads.

McManus [39] developed an injury surveillance form for data collection in rugby union. She extensively checked this for face, content and criterion validity and suggested that this provided researchers with a basis for future studies in this area. The injury surveillance form was reproduced in the paper.

The Western Australian Sports Injury Study, followed-up 1,512 participants of four community level sports – Australian Football, hockey, basketball and netball [24, 25]. It adopted monthly telephone surveys during the playing seasons to collect self-report injury data, which was subsequently validated. The Western Australian Sports Injury Study is the first prospective cohort study of sports injuries sustained during community level sports participation in Australia. The players were non-professional/non-elite participants of hockey, Australian football, basketball and netball from metropolitan Perth. Players completed a baseline questionnaire relating to their sports injury history, training practices, protective equipment use, demographic profile, and general health and lifestyle factors. Sports participation and injury experiences were monitored by monthly telephone surveys over two consecutive five-month winter sporting seasons during 1997 and 1998.

In these, and all sport specific collections, the information obtained, while generally not applicable to other sports, can be expected to make a significant contribution to efforts to reduce injuries, where similar injury types and injury mechanisms occur. Injury surveillance with teams of players or at the club level is very labour intensive and requires very good infrastructure both in terms of staffing and resourcing. For this reason, it has not yet been implemented at the community level.

4.2.7 Local level data collections

Population-based estimates of injury risk need to be determined in well-defined groups such as geographically defined regions.

An epidemiological study of sports injuries occurring within a well-defined geographic region of Victoria has provided the first estimates of sports injury risk in a general Australian population (both participants and non-participants combined) [13]. The Latrobe Valley sports injury study aimed to determine the complete sports and active recreation injury experience, including participation, within
a well-defined regional Victorian population [13]. Australian Bureau of Statistics census data was obtained to determine the size of the Latrobe Valley population. Data on all recorded hospital discharges, emergency department presentations and general practice consultations for sport and active recreation injury were obtained for a 12-month period from November 7, 1994 – November 6, 1995. In addition, a randomised household telephone survey of participation in sport and active recreation and associated injuries was undertaken. Injury rates could be calculated per head of population and per 1,000 participants. This study found that 60% of the population participated in at least one sport/active recreation activity in a two-week period; 5% of these sports participants sustained an injury during this activity. Over half (53%) of the self-reported injuries were significant in that they required treatment or affected participation and/or other activities of daily living. As it was the first population-based study of its kind in Australia, this study confirmed that sport and active recreation injuries are a public health problem and that a significant proportion requires treatment from the health care sector.

The South Australian Report on Young People's Participation in Sports and Recreational Activities and Associated Injury provided results from a 1996-97 survey of 3,500 students in 72 South Australian schools [40]. The students were aged 11-12 and 15-16. Information was collected on injuries of varying severity (not just those resulting in presentation at hospital emergency departments) and on injuries sustained both in organised and in non-organised sporting activities undertaken at various levels. A unique feature of this report was its linkage of data on participation and injury.

Over recent times there has been considerable effort directed towards the collection of local level data. However, such exercises have not always used standardised methodologies or adapted the injury surveillance tools already developed. This means that such studies have lacked a certain rigour. Often too, there has been no attention given towards ensuring high capture rates or representative samples. Overall, such one-off injury surveillance activities, whilst providing useful local data, add little to our understanding of sports injuries in a broader context.

4.2.8 Population surveys

The Latrobe Valley study [13] and Queensland [41] population based surveys have demonstrated that household telephone surveys are a useful methodology for collecting population level data on sports injuries.

The Flinders Centre for Injury Studies will be analysing data from the 2001 National Health Survey (James Harrison, personal communication). This survey is the biggest of its type and surveyed approx 25,000 people across Australia (excluding remote areas). There is potential for some sports injury data to be extracted from this source to provide a picture across the whole range of severities of sports injuries.
4.3 Summary of current status

A key factor in prioritising injury areas is the existence or identification of key injury indicators. Such indicators are needed to demonstrate that policy and other changes have actually led to changes in health status over time. The sports injury area is seriously hindered in this aspect as the quality of the data sources leading to key indicators is very poor [32]. The National Health Priorities Area indicators for injury included two related to sports injuries: Indicator 6.1 – Hospital separation rates for sport and recreation injuries and Indicator 6.2 – non-hospital admitted sport and recreation related activities. Indicator 6.1 is dependent on ICD-coded data but, as Harrison and Steenkamp [32] point out, the extent to which the ICD-10-AM activity codes have been applied to specifically identify sports injuries is currently unknown. This indicator will only be as good as the data coded to sports injuries and it is expected that this may be deficient in current data collections. There are even more problems with identifying data to monitor Indicator 6.2. Without a national data collection on sports injuries, let alone standardised data collection methodologies across the sector, it will not be possible to measure this indicator at all. Harrison and Steenkamp [32] concluded “A viable option for monitoring of non-admitted sports injury does not exist at present.” They suggested that serial population surveys may be the best way to collect such data in the future.

The major injury surveillance initiative since 1997 has been the establishment of the Australian Sports Injury Data Working Party to draw up guidelines for sports injury surveillance. This work has result in the release of a working data dictionary [29]. The working party was disbanded at that time and no national body has since been set-up to develop this data dictionary further. The data dictionary has helped to inform coding schemes for ICD-10 and assisted with a number of other surveillance projects. However, its value beyond these contexts is unknown.

At present, there is little incentive to collect sports injury information at the local level, and no specific body has the responsibility for doing so or for coordinating such activity. This adversely affects both the quality of the data collected and its analysis. The large number of local level projects with their own data collection forms and unstandardised methodologies compound the problem. Limited time data collection exercises are being promoted as injury surveillance activities but they rarely include an ongoing monitoring and recording function. It is laudable that sports bodies and community groups now see the collection of sports injury data as an important activity (and this is a major change since 1997) but ad-hoc data collections add little to our knowledge about sports injuries, except for at the local level. Because of the variable data collection and sampling methodologies they have adopted, it is not possible to even combine or collate the information to provide an epidemiological estimate of the burden of sports injuries in Australia.

The lack of a standardised data collection methodology is still a feature of most sports injury data collections in this country. Standardised methodologies, including data collection forms, have been published for use in sports medicine clinics and by medical...
coverage services. However, the extent to which these are effective or have been adopted is unknown. If injury surveillance activities are fully coordinated and a standardised data collection procedure is implemented, valuable sports injury information could be obtained by medical coverage personnel and used for prevention purposes.

Injury surveillance systems will need considerable money to identify sports injury cases adequately. The narratives are the most relevant and important information to collect from a prevention and case identification point of view but it is very costly to collect this information.

There is currently no lead agency to oversee or guide the future development of an Australia-wide approach to sports injury surveillance. Until such a body is established, injury surveillance activities in this country are likely to remain ad-hoc and it will not be possible to estimate sports injury rates either nationally or across states.
Chapter 5

The incidence of injuries in sport in Australia

The various data sources and the limitations of the existing Australian sports injury data collections were discussed in Chapter 4. This Chapter provides a summary of the available Australian data in order to describe the magnitude of the sports injury problem. Clear gaps in the knowledge are also identified.

5.1 Injury rates across Australia

Little is currently known about the actual incidence of injury during sport and active recreational activity, including physical activity, in the general population in either Australia or overseas. In a recent Australian study, 5% of participants in general sport or active recreation activities sustained an injury during this participation over a two-week period [13]. Amongst injured participants, 27% required treatment and 36% reported an adverse effect of this injury on their performance or participation in sport and active recreation.

The prevalence of sport-related injuries is borne out by Australian Bureau of Statistics (ABS) data collected during the 1995 National Health Survey [42]. This showed that 38% of people who reported an injury occurring in the month prior to the survey or who suffered from an injury-related condition sustained during the previous year acquired their injuries through sport or recreation-related physical activities.

The incidence and public health burden of sports injuries in Australia cannot be adequately determined at present. The Burden of Illness...
and Injury estimates for Australia [43] do not reflect the true burden of sports injuries because (a) such injuries are rarely fatal (b) limitations of the International Classification of Diseases (ICD-9) upon which they are based, prevent adequate identification of sports injuries and (c) most sports injuries are not treated in hospital settings, where patient data would be retained centrally.

While the total number of injuries sustained during sport and physical activity is high, these injuries are not, on average, as severe as injuries sustained in other ways, for example in road crashes or at work. Catastrophic injuries (those causing death or severe and permanent disability) are very rare during sport. In New South Wales, the New South Wales Sporting Injuries Committee has monitored the incidence of catastrophic injuries since 1978-79. On the basis of insurance claims in that State, the sports with the highest risk of catastrophic injury are rugby union and rugby league, although figures for each are very low (John Anderson, personal communication).

Data about deaths due to injury are available from the Research Centre for Injury Studies' website [44]. This death data was compiled from ABS, State Registrar of Deaths and Coroners' sources. For 1998, the rate of death due to collision in sport is given as a null value because there are too few cases to give meaningful rates. The death rate due to being struck by an object or person in sport was 0.1/100,000 population for both 10-14 and 15-24 year olds but null for all other age groups.

Tate et al [45] examined the hospitalised medical records of 413 cases of head trauma (with subsequent brain injury) in the North Coast Health Region of NSW. Of these, one-quarter was due to sport and recreation, ranking second only to road trauma as a cause of head trauma. Although road trauma was more prevalent in the deaths and severely injured cases, there were very similar numbers of moderate and mild head trauma cases due to sport/recreation and road trauma. Sport and recreation was the most common cause of hospitalised head trauma (47% of all cases) in children aged 5-14 years.

A Victorian study described the epidemiology of medically treated injury in that State [46] and found “areas for sport and recreation” to be the second most location for injuries (after the home). They accounted for 9% of deaths, 8% of hospitalisations and 13% of non-hospitalised injuries. Overall, sports injuries accounted for 0.1% of all fatalities, 3.5% of hospitalised injury cases and 7.7% of non-hospitalised cases. The data used to generate these figures, however, is likely to be an underestimate of the problem as specialist sports medicine clinics and other similar places of treatment were not included. Estimates of the incidence of sports related injuries in Australia rely heavily upon figures for hospital presentations and are therefore expected to be an underestimate of the total number of injuries, the majority of which do not require or receive hospital attention [14].

At present there is no database available that allows a direct comparison of sports injury rates in different States or regions of Australia.

The Latrobe Valley sports injury epidemiological study has provided valuable information about the incidence of sports injuries in a general population [13]. This study involved a household survey of sports and active recreation participation and associated Injuries. As Figure 1 shows, of the 60% of the survey population who participated in some form of sport and active recreation in the two weeks prior to the survey, 5% sustained an injury. Almost a third of all injured cases required treatment for this injury. Given the large numbers of Australians who participate in sport and active recreational pursuits, these figures demonstrate the public health importance of sports injuries.

Another population-based household telephone survey of 1337 individuals was conducted across Queensland [41]. Of the people surveyed, 191 people reported a total of 222 injuries requiring medical treatment in the previous 12-months. This corresponded to an injury rate of 1.7 medically attended injuries per 10,000 people. The 18-30 year old group had a significantly higher rate of injury than people of other ages. The surveyed sample reported participation in 43 different sports and physical activities but more than half of the injuries were associated with just nine activities: walking, gym, jogging, martial arts, tennis, touch football, rugby league, basketball and netball. The rate of medically treated injury was highest in rugby league (583 injuries/1000 participants) followed by basketball (579 injuries/1000 participants), martial arts (563 injuries/1000 participants) and netball (323 injuries/1000 participants).

The Western Australian Sports Injury Study (WASIS) was the first prospective study of injuries incurred during participation in four sports at the community level - hockey, Australian football, basketball and netball [24, 25]. The incidence of injury at the community level of participation was 16 injuries per 1000 playing hours [24, 25].
injury rate was highest in Australian football and lowest in netball. Translated to practical terms, the incidence of injury was estimated to be equivalent to:

- two injuries among a squad of 20 Australian footballers who participate in one game and 1.5 training sessions;
- one injury among a squad of 11 hockey players who participate in three games and four training sessions;
- one injury among a squad of 10 basketballers who participate in five games and six training sessions;
- one injury among a squad of seven netballers who participate in seven games and seven training sessions.

There is a paucity of information about sports injury risk in Aboriginal people. From time to time, there has been public comment about a potentially heightened risk of sudden cardiac death during sport in athletes of Aboriginal descent. One study examined death statistics and coronial autopsy records in the Northern Territory for the period 1982-1996 [47]. The risk of ischaemic heart related cardiac death amongst Aboriginal Australian football players in the Northern Territory was estimated to be 19-24 per 100,000 player years compared to only 0.54 per 100,000 player years for an age-matched group of Australian football players in Victoria.

As there are currently no agreed measurements of severity, it is difficult to compare the findings of the various Australian studies, which have attempted to estimate the severity of sports injuries. One measure of severity is the cost of treating the injury. The issue of costs is discussed in Chapter 7. Another measure is the rate of hospitalisation. In Australia, only significant injuries are generally treated at emergency hospital departments and only the most severe result in hospitalisation. The Western Australian Sports Injury Study classified the severity of the injuries into three levels [24, 25]:

- severe – requiring hospitalisation;
- moderate – seeking health care attention;

In the WASIS, injuries of a moderate severity were the most common. Sixty-five percent of injured players sought treatment from a health care practitioner. Minor injuries accounted for 31% and severe injuries for 4% of the injuries sustained during the study period [24, 25].

The patterns and causes of injuries during organised sport has recently been described in the rural area of the Mackay region in North Queensland [48]. This region has a population of 125,000 (or 3% of the total Queensland population) but records 7% of all injury/poisoning hospital separations in the State [49]. Level 2 National Data Set-Injury Surveillance data was collected by the Mackay Base Hospital Emergency Department during 1998-2000. Overall, data was collected on 2,849 injuries, representing 11% of all injury presentations to that emergency department over the period of data collection. This proportion is similar to that previously reported in Australia [14]. More than half (52%) of the treated cases were aged under 19 years of age, highlighting the priority of adolescent sports injury prevention. As with other injury surveillance studies in other parts of Australia, the football codes accounted for the highest proportion of injuries (68% of all male injuries). Netball and basketball accounted for the highest proportion of female injuries (31% of the total).
5.2 The nature of sports injuries

Information on the nature of sports injuries supports the view that the majority are at the lower end of the severity spectrum and do not place much of a burden on the healthcare system. In the Latrobe Valley Study [13], fewer than 30% of all sports injuries received medical treatment and just over half of these cases attended a hospital. Strains and sprains may place lower demands on the healthcare system than other injuries (for example, concussion) but they can still have a significant impact on quality of life and subsequent participation in sport and physical activity. The 1995 National Health Survey, for example, found that dislocations, sprains and strains were the most common sport and recreation related injuries, accounting for 36% of all sports injuries. These were followed by bruising and crushing (26%) and open wounds (25%). In the Latrobe Valley study the figure was 39% [13]. The recent Western Australian study found that certain types of injuries are more likely to result from different sports. Of the 507 injuries reported for hockey, the most common was contusion/haematoma (37%). For football injuries, the most common injury was muscle strains or tears (33% of the 925 injuries reported). Ligament strains or tears were the most common injuries reported in both basketball (36%) and netball (36%) [24, 25].

The pattern of body regions injured and natures of injury vary according to the source of injury data. More severe cases tend to be treated at a hospital setting and so injuries such as concussion are frequently reported. On the other hand, General Practitioners (GPs) and sports medicine clinics are more likely to treat sprains and strains. These patterns and differences are emphasised in data collected from hospital admissions, hospital emergency departments and GPs in the Latrobe Valley over a 12 month period (see Tables 2 and 3) [13].

The profile of Australian Rules Football injuries presenting to sports medicine clinics was described in detail by Gabbe and Finch [50]. This study added to the literature by describing injuries to general football participants that were not severe enough to attend an emergency department or to be hospitalised. Overall, 29% of all sports injuries treated by five sports medicine clinics in metropolitan Melbourne over a 12 month period were in Australian Rules Footballers. Of the 1868 cases described, 78% of injuries occurred during formal competition and 78% in adult, community league players. Not surprisingly, body contact was responsible for the majority of all injuries and injuries to the lower limb were the most common: medial ligament sprains of the knee (7% of all injuries), lateral ligament sprains of the ankle (6%) and anterior cruciate ligament injuries (4%).
Table 2: Proportion of medically treated sports injury cases with injuries to specific body regions in the Latrobe Valley during 7/11/94 to 6/11/95
(Source: Finch, Cassell, Stathakis 1999)

<table>
<thead>
<tr>
<th>Body region injured</th>
<th>Hospital admissions (n=113) %</th>
<th>Emergency department presentations (n=1179) %</th>
<th>General practitioner consultation (n=1003) %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper extremity</td>
<td>33</td>
<td>39</td>
<td>43</td>
</tr>
<tr>
<td>Head and face</td>
<td>30</td>
<td>20</td>
<td>14</td>
</tr>
<tr>
<td>Lower extremity</td>
<td>24</td>
<td>31</td>
<td>45</td>
</tr>
<tr>
<td>Abdomen, pelvis</td>
<td>6</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Trunk</td>
<td>–</td>
<td>6</td>
<td>9</td>
</tr>
<tr>
<td>Other/unspecified</td>
<td>8</td>
<td>4</td>
<td>3</td>
</tr>
</tbody>
</table>

Table 3: Nature of medically-treated sports injuries in the Latrobe Valley during 7/11/94 to 6/11/95
(Source: Finch, Cassell, Stathakis 1999)

<table>
<thead>
<tr>
<th>Nature of injury</th>
<th>Hospital admissions %</th>
<th>Emergency department presentations %</th>
<th>General practitioner consultation %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fractures</td>
<td>44</td>
<td>18</td>
<td>13</td>
</tr>
<tr>
<td>Intracranial (not skull fracture)</td>
<td>19</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Dislocations</td>
<td>10</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Open wound</td>
<td>6</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Sprains/strains</td>
<td>6</td>
<td>23</td>
<td>44</td>
</tr>
<tr>
<td>Bruises, haematomas, crushing</td>
<td>4</td>
<td>14</td>
<td>26</td>
</tr>
<tr>
<td>Internal (chest/abdomen/pelvis)</td>
<td>4</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Abrasion</td>
<td>–</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>Inflammation</td>
<td>–</td>
<td>13</td>
<td>9</td>
</tr>
<tr>
<td>Cuts and laceration</td>
<td>–</td>
<td>16</td>
<td>9</td>
</tr>
<tr>
<td>Other injuries</td>
<td>8</td>
<td>6</td>
<td>5</td>
</tr>
</tbody>
</table>

In the WASIS study, all players were non-professional/ non-elite participants of hockey, Australian football, basketball and netball from metropolitan Perth [24, 25]. Across all sports, the injury incidence rate was 16.1 injuries/1000 exposure hours (both games and training). Injury rates were highest in Australian football and lowest in netball. Lower limb injuries were twice as common as those to the upper limb (67% versus 31%). Three quarters of injured players sought treatment from a health care practitioner. The most common injury locations were the ankle, thigh and knee with some variations across sports. Netball and basketball participants were more likely to sustain ankle injuries and Australian Rules Footballers most likely to sustain thigh injuries. The most common injuries in this study were muscle strains or tears (28%), bruising (25%), ligament sprains or tears (20%) and broken bones (6%).
5.3 Injury rates across sports

It is generally not possible to accurately compare injury risk across sports because of the varying methodologies used in different studies. However, some facts have emerged over recent years. The risk of injury is much greater in some sports than others, when rates are adjusted for hours of exposure. Contact and team sports carry the greatest risk of injury.

Among patients presenting to general practitioners with sports related injuries in a 12 month period in the Latrobe Valley, the highest rate of injury was associated with Australian Rules Football (22%), followed by basketball (18%) and cycling (13%) [13]. The most common types of injury are sprains/strains (39%), bruising (23%) fractures (11%) and inflammation (8%).

An analysis of emergency department presentations for 1999-2001 in Victoria [52] found the sports activities most commonly associated with such presentations to be:

- Australian Rules Football (20% of all sport and active recreation cases),
- Basketball (8%),
- Soccer (6%),
- Netball (5%),
- Cricket (4%).

A survey of school children in Adelaide was conducted in 1997. A validated questionnaire was administered to 3358 girls and boys aged 11-12 and 15-16 years [40, 53]. Of those who participated in sport and/or recreational pursuits, 25% reported at least one injury in the week prior to the survey but the majority of the injuries were only minor (including things such as bruising, aches/pains or gravel rash). The study found a significantly elevated risk of injury in seven activities: martial arts, hockey, Australian Rules Football, rollering, netball, soccer and basketball. The interpretations from this study are limited, however, because the data was all self-reported from the adolescents and not validated. In addition, a clearer definition of injury may have led to different injury rates reported.

A limitation of the above figures is that they have all been based on case frequencies and may therefore reflect the popularity of particular sports, and not necessarily reflect true injury risk. The first population-based study to address this issue in Australia was conducted in the Latrobe Valley. Table 4 summarises the findings of that study with respect to sports most commonly associated with sports injuries, when numbers of participants in the sports are taken into account [13].

The rank order of rates of population participation per 10,000 persons over 4 years of age were: walking 2,315; swimming 746; bicycling 710; basketball 712; Australian Rules Football 477 [13]. The rank order of medically treated injury frequency by sport, however, was Australian football, basketball, bicycling, netball, cricket and soccer. Based on self reported data from the community survey in the Latrobe Valley, the sport and active recreation activities with the highest rates of injury per 1,000 participants were: cricket (242/1,000), horse riding (122/1,000), soccer (107/1,000), netball (51/1,000) and Australian Rules Football (37/1,000) [13].

The authors of the Latrobe Valley report concluded that participation in ball team sports, rather than individual pursuits such as walking, are the most likely to be associated with increased injury risk [13]. They recommended that injury prevention efforts should be aimed at the following priority sports:
* bicycling because of a high frequency of medically treated injury and the severity of injuries;
* Australian Rules Football and basketball because of a high frequency of medically-treated injury (note that rugby was not featured in this study as it was based in Victoria);
* other team ball sports (especially cricket, soccer and netball) because of comparatively high rates of injuries per 1,000 participants; and
* horse riding because of the comparatively high rate of injuries per 1,000 participants and frequency of hospital admissions.

Table 4: Sport and active recreation activities with highest rates of injury per 1,000 participants in the Latrobe Valley
(Source: Finch, Cassell, Stathakis 1999)

<table>
<thead>
<tr>
<th>Activity</th>
<th>Injuries per 1,000 participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cricket</td>
<td>242</td>
</tr>
<tr>
<td>Horse-riding</td>
<td>122</td>
</tr>
<tr>
<td>Soccer</td>
<td>107</td>
</tr>
<tr>
<td>Netball</td>
<td>51</td>
</tr>
<tr>
<td>Australian Rules Football</td>
<td>37</td>
</tr>
<tr>
<td>Basketball</td>
<td>37</td>
</tr>
<tr>
<td>10 pin bowls</td>
<td>36</td>
</tr>
<tr>
<td>Tennis</td>
<td>23</td>
</tr>
<tr>
<td>Walking</td>
<td>9</td>
</tr>
</tbody>
</table>

Based on household telephone survey reported activities with >20 participants.  
Note: scaled up from a small but representative sample of injury cases.

In findings from the WASIS epidemiological study referred to earlier, Australian Rules Football had the highest incidence of injury among the four sports studied, at 20 injuries per 1,000 hours of participation (in training and games) [24, 25]. This compared with 15 injuries per 1,000 hours of participation for hockey, 14 for basketball and 12 injuries for netball. In contrast, a prospective study of basketball players in Victoria reported an overall injury rate of 24.7 per 1,000 playing hours [21].

The injury incidence rates for basketballers and netballers in the WASIS were lower than those reported in previous studies and are likely to reflect the more recreational level of the players studied [24, 25]. In one Australian study, incidence rates ranged from 18.2 injuries per 1000 participations hours in elite netballers to 17.3 injuries per 1000 participations in recreational basketballers [54].

This WASIS also highlights a gradation of injury risk across the sports studied. The significantly higher risk of injury in Australian Rules Footballers is consistent with this sports' prominence in sports injury data from emergency departments, sports medicine clinics and general practitioners [14, 16, 50]. As would be expected from the nature of the games, Australian Rules Football and hockey were associated with the highest injury rates. These sports have a significant risk of collision with another player or hit from a ball/stick. On the other hand, both netball and basketball are non-collision sports and therefore associated with a lower risk of injury.

Most published studies only report injury rates adjusted for exposure during formal games or competition. This reflects the belief that injury rates are greatest during competitive sport. However, this implicitly assumes that there is no risk of injury during training activities and this is clearly not the case. The WASIS rate is lower than that reported amongst professional players, indicating that community level players have a reduced risk of injury, compared to their professional counterparts. For example, the overall incidence of Australian Rules Football injuries in elite players has been reported as 55 injuries/1000 (training and games) exposure hours [55], compared with the rate amongst players in the WA study of 20/1000 hours. The only other study to report incidence rates in community level Australian Rules Football, monitored injuries from an amateur club over one playing season and determined an incidence rate of 96 injuries/1000 hours [56]. However, that study did not include training hours in the exposure calculation, hence the elevated incidence compared with this study. The time spent participating in physical activities, is considerably different for training as compared to match play. The nature of the activities, including open versus closed drills, contact, intensity etc also differs according to training or match conditions.
5.4 Injury rates across age groups and genders

Despite different data collection methodologies and source of the injury data, some clear trends with regards to injury risk in age groups and gender are apparent.

Sport is a common context for fall injury in children [57]. In hospitalised children aged 0-14 years, falls (in sport, on same level from collision, pushing or shoving by or with other persons) was ranked as the third highest fall mechanism after falls from playgrounds and fall on same levels. Sport accounted for 8.1% of all child fall hospitalisations in Australia during 1997/1998. The rate was much higher in 10-14 year olds, amongst whom almost 25% of injuries occurred in a place for sport or recreation.

According to the SMIS project the majority of people with sports injury treated at sports medicine clinics are aged between 20-59 years [17]. This is quite different to the age distribution of sports participants. This could be either due to an excess risk of sports injuries amongst this age group, particularly amongst those aged under 40 years of age or the possibility that people in this age group are more likely to attend a sports injury clinic. While the sports injury rate parallels the sports participation rate, both of which peak in the 18-24 age group and decline thereafter, even when adjusted for exposure the injury rate remains highest for this group. A major reason for this is that younger players are more likely to play team and contact sports such as Australian Rules Football and netball, for which injury rates are high. Older players are more likely to play sports with lower injury rates, such as lawn bowls and golf. Even when they play contact sports, it may be that older players may be slower and more risk averse than younger players. Some sports have specific rules according to the age of participants.

According to the Latrobe Valley sports injury study, children aged 5-14 years have the highest rate of significant injuries (12.3 injury cases per 1000 participants) [13]. In particular, children have the highest rate of injuries requiring treatment and affecting performance or participation in activity (7.4 per 1,000 participants). This highlights the need to target children for injury prevention activities, especially if life-long participation in physical activity is desired.

On the other hand, on the basis of injury frequency, the Latrobe Valley study suggests that sports injury prevention activities should be targeted to the 15-39 year old age group, as this group has the highest overall rate of injury (26 injuries per 1000 participants). The differences in the rates of injuries in three broad age groups are shown in Table 5.

The WASIS Injury cohort study enrolled sports participants aged 15+ years [25]. The rate of injury was lowest in those aged under 18 years and highest in the 26-30 year olds [24]. The reason for this was not able to be explored but could be related to a longer history of playing, and hence greater chance of having an injury history, in the older players.
Table 5: Rate and impact of sports injuries (per 1,000 participants) in each age group in the Latrobe Valley.
(Source: Finch, Cassell, Stathakis 1999)

<table>
<thead>
<tr>
<th>Age-group</th>
<th>All sports injuries</th>
<th>Injuries requiring treatment</th>
<th>Injuries affecting daily activities</th>
<th>Injuries affecting performance or participation</th>
<th>Significant injuries (i.e. those requiring treatment or affecting daily activities or participation or performance)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-14 years</td>
<td>22.1</td>
<td>7.4</td>
<td>7.4</td>
<td>7.4</td>
<td>12.3</td>
</tr>
<tr>
<td>15-39 years</td>
<td>26.1</td>
<td>4.9</td>
<td>8.2</td>
<td>6.5</td>
<td>9.8</td>
</tr>
<tr>
<td>40+ years</td>
<td>14.2</td>
<td>5.3</td>
<td>5.3</td>
<td>7.1</td>
<td>7.1</td>
</tr>
</tbody>
</table>

Sports injury rates have consistently been reported to be lower among females than males. The differential applies to all age groups when adjusted for participation rates. The Latrobe Valley study, for example, indicated that among people presenting with sports injuries at the Latrobe Regional Hospital in 1991-93 males were over-represented among both children and adults. They accounted for 76% of all those with sports injuries presenting for treatment during that period [13].

A similar gender breakdown was observed during a 1997 survey of patients presenting with sports related injuries to a general practice clinic in Melbourne [16]. In this study, 80% of patients were male.

In the recent WA study, the injury incidence rates were significantly higher among males with 19 injuries per 1000 hours of sports participation compared to 13 injuries for females [13, 25]. Males had a significantly elevated injury incidence, compared to females in the WA sports injury study [24]. Although this is related to the sports being played (all footballers were male and most netballers female), the finding was also observed in the two sports with almost equal number of males and females (i.e. hockey and basketball). Alternatively, men may be more likely to report a sports injury than women.

The New South Wales Chief Health Officer estimates that sports injuries account for about 8,000 hospitalisations in that State [58]. The rate of sports injury hospitalisations was highest in males and in persons aged 10-34 years. However, males over represent the number of physical activity participants, especially in team sports.
5.5 Summary of current status

It is not possible, with current available data to compare injury rates across different States or other regions of Australia, nor is it generally possible to compare injury risk across sports. This limits the ability to rank activities for priority setting. Furthermore, there is no baseline against which injury prevention gains can be monitored.

The Western Australian sports injury study is the first prospective cohort study of sports participants in Australia and has demonstrated a gradation of injury risk from highest in Australian football to lowest in netball (with field hockey and basketball have intermediary rates of injury).

Different patterns of injury, in terms of body region and nature of injury distributions, are evident when data from different sources is combined. Data collected in hospital settings is necessarily corresponding to more severe injuries than that collected through general population surveys. Generally, soft tissue injuries such as sprains and strains are the most common, as are injuries to the lower limb.

Sports injury risk appears to be higher in males and younger persons. This is likely to be related to participation levels and the types of activities that males undertake (for example, competitive football) compared to females.
Chapter 6

Risk and protective factors

Information about the characteristics of players at risk of sports injury is crucial for the development of effective injury prevention strategies. Indeed, the identification of both risk and protective factors is essential in the planning and development of strategic public health initiatives for the prevention of sports injuries at the community level. Community sports injury studies are needed for a comprehensive description of the problem across the broad spectrum of injury severity, as injury profiles and associated risk factors are different for professional and community sports.

To date, there has been little aetiological research to identify the risk factors and actual causes of sports injury in community level sport in Australia. When risk factors have been considered, they have generally been examined in elite athletes.

Muscle strains are common in Australian Rules Footballers and Orchard investigated the intrinsic and extrinsic risk factors for such injuries in elite footballers over 83,503 player matches [59]. His study focused mainly on hamstring, quadriceps and calf muscle strains and he found recent history of the same injury to be the strongest risk factor, followed by a past history of the same injury. Age was also found to be a risk factor for hamstring and calf strains. Quadriceps injury risk was related to player stature, leg dominance and rainfall during the previous week. Whether the same factors hold the same level of risk for community level footballers is not known.

Verrall et al [60] conducted a small scale prospective study of hamstring muscle strain injuries in elite Australian Rules Football players. Like other studies, they found previous injury history, particularly prior thigh injury, to be the most important predictor.

Over recent years, there has been increasing attention paid towards the surfaces and ground conditions that sport is played on and its potential to influence injury risk. This has been particularly the case for football codes internationally [61]. A very recent review concluded that the shoe-surface interaction is likely to be one of the major factors in the aetiology of lower limb injury in football, across many codes [61]. Most of the evidence backing this statement comes from studies of high level and elite football competitions. Nevertheless, there are many consistencies across studies with a higher predominance of non-contact injuries earlier in the season and differential injury rates on different surface types (for example, artificial turf vs. natural grass in American football). Although the studies have all been conducted with high-level athlete cohorts, the results are likely to be applicable to lower levels of play. Accordingly, shoe design, ground composition and ground hardness are all factors that need to be investigated further in community level sport.
One of the postulated links with ground conditions is the observation that many injuries occur early in the playing season [61]. The WASIS cohort study found a higher incidence of injuries across four sporting codes during the first month of the study. However, this elevated incidence was not repeated in the 2nd year of the study [24]. The authors considered that this was likely to do with the recruitment of study participants and their enthusiasm for the study protocol in the early stages of the project, rather than a true early season effect.

It has been suggested that one of the factors that has impacted on injury risk in elite Australian Rules Football over time is the increasing speed of the game, as well as changes in player profile characteristics such as player heights and mass [62]. This conclusion was based on an analysis of elite level Australian Rules Football, and whilst the study is yet to be replicated in community Australian Rules Football, the expectation is that a similar change in injury risk due to these factors will also be shown. The study in elite Australian Rules Footballers [62] also suggests that the tempo of the game and not just the amount of accrued hours of play needs to be taken into consideration in the calculation of injury risk. In a later study, relating injury occurrence to the evolution of the elite Australian Rules Football game [63], these authors added ground hardness and playing level to their risk factors for injury. The incidence of injuries in the Australian Wallabies (elite) rugby union team has also been shown to correlate with changes in the speed and professionalism of the game [64].

McKay et al [22] conducted a prospective observational study of injuries in one elite and three recreational basketball competitions in Melbourne. A game-side observer recorded injuries. As ankle injuries are the most common injured region in basketballers, a particular focus was on ankle injuries. Three independent significant risk factors for ankle injury were found:

- players with a history of previous ankle injury had an elevated risk of injury Odds ratio (OR)=4.94 (1.95-12.48);
- players with shoes with air cells in the heel were more likely to be injured than those wearing shoes without air cells OR=4.34 (1.51-12.40);
- players who did not stretch before the game were more likely to be injured OR=2.62 (1.01-6.34).

Despite the gaps and inconsistencies in information on sports injuries, enough is known to guide some efforts to reduce the number of injuries and their severity. The current information provides a good understanding of those sporting activities which, because of their intrinsically risky nature or because of the large number of people participating in them (or both), carry a significant risk of injury. This means that sub-groups of participants who are at high risk of injury can be identified. The reports listed in Appendix 1 describe the factors most likely to contribute to injury in the various sports considered and the nature and severity of the injuries likely to be sustained.

A baseline survey of 1500 participants of Australian Rules Football, basketball, netball and hockey was conducted and injuries monitored prospectively over the following two playing seasons. This study
has shed some important light on both potential risk and protective factors for injury in these four sports played at the community level. Figure 2 shows the incidence rate ratios (IRR) obtained from this study. An IRR greater than 1 indicates an increased risk of injury (i.e., a risk factor) and an IRR significantly less than 1 indicates a protective factor. Three significant risk factors were identified:

- people with back problems were prone to sports injury (IRR=1.69);
- an injury sustained in the previous season increased the risk of further injury (IRR=1.45);
- players who had the personality characteristics of “extraversion” and “openness” were also more at risk.

**Figure 2.** Incidence rate ratios (95% CI) indicating risk and protective factors for sports injuries in community sports
(Source: Sports Medicine Australia, WA branch, 2001)

The study also identified six overall protective factors [65]:

- participation in a sport specific training program (IRR=0.68), particularly one designed by a qualified exercise/sport professional;
- previous experience in the sport (in the previous season) - i.e., not being a novice (IRR=0.71);
- being a non-drinker (perhaps as a proxy for a healthy lifestyle) (IRR=0.82);
- being generally physically active (IRR=0.92);
- self-rating of having high endurance (perhaps as a proxy for fitness).

In 2001, there was considerable public debate about whether or not pregnant women should participate in sport [66, 67]. This was precipitated by Netball Australia's banning of participation by pregnant women. A discussion of the injury risks to both the mother and unborn child were crucial to this debate. Although trauma to pregnant women is a potential risk during sport, as there is no published information about the magnitude of this risk, it is presumed to be low [68]. Whilst there is an emerging literature about the risk of adverse outcomes following severe and catastrophic trauma to pregnant women, this literature almost exclusively focuses on road trauma victims or the result of assault. An analysis of Australian data confirmed that the risk of
Abdominal injury during sport is very low [68] and the author concluded that currently there is not an adequate evidence-base for quantifying the risk of abdominal injuries during sport in women, let alone pregnant women or for justifying a ban of sport on this basis.

Lower extremity injuries are the most commonly reported injuries in sport. A review of risk factors for lower extremity injury in sport has recently been published in the British Journal of Sports Medicine [69]. The review considered both intrinsic and extrinsic risk factors and presented the evidence supporting these factors. The range of factors considered reflects the wide disparity of the literature which consists of conflicting study results, low powered studies, inconclusive results, poor case definition and both inconsistent and unvalidated methodologies. Table 6 summarises the major conclusions about injury risk factors from this review. In addition to these risk factors, the authors concluded that there is strong evidence for the use of ankle tape or bracing to reduce the risk of ankle injuries. However, in the study of Melbourne basketballers, the trend towards ankle taping reducing ankle injury risk was not significant [22].

Gabbe [70] conducted aetiological research in amateur Australian Rules Football players for the first time. Her particular focus was on identifying predictive factors for the time to occurrence of lower limb injuries in these players, and hamstring injuries in particular. An important finding was that when all lower limb injuries were combined, it was hard to identify predictive factors because of the diversity of injury types (from ankle injuries to knee injuries to thigh haematomas, etc). However, when the outcome of interest was restricted to the time until the first hamstring injuries the following exposure-adjusted risk factors were age (older players more at risk) and quadriceps flexibility (reduced flexibility most at risk).

A number of the recent advances in sports medicine were summarised by Bahr in 2001 [71]. Bahr had used the Medline database to identify relevant literature and three of the six highlighted recent advances he listed were related to injury prevention:

- balance training and taping of the ankle prevents recurrent ankle sprains;
- balance training and strength and agility training can prevent knee injuries;
- balance training may also prevent injuries to the anterior cruciate ligament.
Bahr has, himself, conducted research into the effectiveness of balance training and this may have influenced his highlighting of this prevention measure, in particular.

Over the past five years, the “new” information about sports injury risk factors has largely come from epidemiological studies [22, 59, 61, 65, 72]. Importantly, the findings of these studies, such as the WASIS, all need to be reproduced in further samples. It also needs to be noted that such epidemiological studies can only identify potential risk factors and need to be supplemented by biomechanical/biomedical research to confirm their role in injury causality and to provide biologically plausible mechanisms for their observed effects. This is akin to most other medical research, which requires both basic biomedical science, and as well as applied research to develop preventive measures to address disease causal factors.

Over recent years, there has been an increasing recognition of the need to combine biomechanical and epidemiological approaches to tackle the sports injury problem [73, 74]. Such partnerships are necessary to both fully understand injury causality and to guide the development and evaluation of countermeasures [75]. An example of such a partnership is a nested case-control study conducted within the WASIS Study [65]. Participants with a knee injury from the larger cohort study were approached and invited to undergo specific biomechanical and other testing of their knees to identify risk factors for knee injuries. Controls were other cohort members who did not have a knee injury. Two independent risk factors were identified for knee injury:

- having weaker hamstring muscles,
- having a history of sports injury (in the previous season).

The strength of these findings is limited because of the study design being a retrospective case-control study. However, they do provide insight for the design of a randomised controlled design to address these risk factors.
6.1 Summary of current status

Epidemiological studies have started to provide evidence for potential sports injury risk factors. The WASIS has provided the best information about risk factors for sports injury in community participants of four sports. Identified risk factors included previous injury, particularly a back injury, and certain psychological profiles. Protective factors were being adequately prepared for the game by participating in formal training, having experience in a sport, being generally healthy and having high physical endurance. However, this study needs to be reproduced in other player cohorts and sports and the identified risk factors explored in further aetiological studies. There is a need to combine epidemiological, biomechanical and medical approaches to take this forward.

Injury history is consistently identified as an injury risk factor, suggesting that poor/inadequate rehabilitation or injury susceptibility (for reasons unknown) need to be addressed.

It has been suggested that lower limb injuries, particularly in elite Australian Rules Football, are related to ground conditions and surfaces or the pace of the game. However, specific examination of these factors in community-level sport has yet to be undertaken.
Chapter 7

The cost and other impacts of sports injuries

The costs and benefits of participation in sport and other physical activities, though difficult to quantify, are widely acknowledged. These costs and benefits are applicable to individuals, to governments, to employers and to the general community. The major costs of participating in sport, apart from participation fees and equipment costs are associated with injuries sustained by participants. A summary of the range of potential costs and other adverse outcomes associated with sports injuries is shown in Table 7 below.

Government promotion of participation in sport and physical activity is motivated primarily, but not exclusively, by recognition of its health benefits to individuals, and concomitant savings to health budgets. However, participation in sport exposes individual participants to the risk of injury, thereby negating some of the health benefits associated with physical activity [6, 76]. As more people participate in sporting activities, the injuries associated with these activities can be expected to increase. Thus the benefits of increased physical activity must be weighed against the likely increase in associated injury costs [77].

Table 7: The potential adverse outcomes of sport and physical activity injuries
(Source: Finch and Owen 2001)

<table>
<thead>
<tr>
<th>Prevention or limitation of participation by:</th>
</tr>
</thead>
<tbody>
<tr>
<td>● leading to time lost from sport/physical activity</td>
</tr>
<tr>
<td>● leading to non-participation</td>
</tr>
<tr>
<td>● limiting athletic participation/performance (in terms of frequency, duration, etc)</td>
</tr>
<tr>
<td>● limiting performance (achievements), whether or not there is also time lost to sports/physical activity</td>
</tr>
<tr>
<td>● being potentially career threatening to elite athletes and others who can no longer perform their work</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Affecting the health of participants by:</th>
</tr>
</thead>
<tbody>
<tr>
<td>● causing permanent physical, psychological or emotional damage and disability</td>
</tr>
<tr>
<td>● creating significant treatment needs (for example, surgery, ongoing management, etc)</td>
</tr>
<tr>
<td>● creating significant rehabilitation needs</td>
</tr>
<tr>
<td>● resulting in fear of future injury</td>
</tr>
<tr>
<td>● resulting in non-participation and subsequent implications for future health status</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Significant financial costs through:</th>
</tr>
</thead>
<tbody>
<tr>
<td>● resulting in:</td>
</tr>
<tr>
<td>— health system expenditures</td>
</tr>
<tr>
<td>— health insurance costs</td>
</tr>
<tr>
<td>— costs of insurance against injury</td>
</tr>
<tr>
<td>● being associated with other financial costs to the individual</td>
</tr>
<tr>
<td>(for example, protective equipment such as braces)</td>
</tr>
<tr>
<td>● being associated with significant costs to industry (both sporting and employment)</td>
</tr>
<tr>
<td>● being associated with loss of potential income for individuals and sporting clubs/organisations</td>
</tr>
<tr>
<td>● being associated with time away from school/work/home duties</td>
</tr>
</tbody>
</table>
7.1 The direct costs of sports injuries

While many of the direct medical costs of treatment and rehabilitation for sports injuries are borne by governments (that is, taxpayers) a significant proportion are incurred by the affected individuals who also bear most of the indirect costs of injury.

Egger estimated the annual cost of sports injury in Australia in 1990 at approximately $1 billion [79]. About half of this estimated figure was ascribed to direct medical costs and the rest to time lost from work. The total figure represented 8% of the cost of all injuries occurring in that year. Although, Egger's cost figures were based on questionable methodology, and they are now almost 15 years old, they remain the only available figure on the cost of sports injuries in Australia.

The Australian Institute of Health and Welfare and the Centre for Health Program Evaluation estimated the direct and indirect costs of obesity in 1989-90 to be $1.2 billion. This figure is quite similar to that estimated by Egger for the cost of sports injuries at the same time. Obesity has since been identified as one of the most important health issues in this country and attracts significant infrastructure, government support and research dollars.

Sports injuries were found to rank as the second highest cause, after transportation, of lifetime injury costs in Victoria, accounting for an estimated $556 million, or 21% of all injury costs. However, this figure excluded recreational injuries and injuries treated in sports medicine clinics and by para medical personnel. It is therefore almost certainly a gross underestimate.

Further direct costs of injury which are difficult to quantify because of the time lag between the precipitating event (trauma or overuse) and the appearance of symptoms are those associated with the development of osteoarthritis and related joint conditions sustained during participation in sport or physical activity. This would considerably add to the total burden of sports injury in Australia.

The recent WASIS estimated the costs of sports injury in Western Australia for hockey, Australia rules football, basketball and netball [65].

Direct costs included treatment and hospital costs and indirect costs included productivity losses and time spent in hospital. It was estimated that the cost of sports injury to an injured player per season (across the four sports) was $251. This equated to a total cost to Western Australia of injuries to participants of the four sports of approximately $9.74 million for 1997/98.

The Mackay sports injury study estimated the costs of sports injuries presenting to the Mackay Base Emergency Department in 1998/99 based on costs from funding of ambulatory services [48]. The overall cost for emergency department treatment was $283,680 in a population of size 125,000.

One study summarised the expected outcomes of Australian Rules Football injuries presenting to sports medicine clinics for treatment [50]. Overall, 54% of injured players were expected to need 3-8 weeks of rehabilitation before they could return to full participation in their sport. Only 15% of players were referred outside the sports medicine clinic for further treatment—of these, 1 in 10 was referred directly to hospital and 4 in 10 to an orthopaedic surgeon. This has implications for costing strategies and emphasises the need to consider the cost of treatment at a variety of places.

Kirk et al [80] investigated the financial demands placed on families for the participation of a child in junior sport, including medical expenses (presumably largely for injury treatment). Based on the data provided in the paper, it can be estimated that parents spend an average of approximately $117 per annum for medical expenses associated with their child's participation in sport. Parents of junior footballers paid more medical fees than parents of children who played other sports. This can be estimated to be an average of $174 per annum or 1.5 times the amount for participants of other sports. Ten percent of parents of footballers paid more than $500 per annum in medical fees associated with sports participation, compared with just 3% of families with children participating in other sports. These cost estimates reflect the high risk of injury whilst playing Australian Rules Football, compared with other sports, and an increased likelihood of severe injury.
7.2 The indirect costs of sports injuries

Most sports injuries do not require treatment at a hospital and incur relatively few financial costs to the health care sector. However, the limited information suggests that overall indirect costs are significant. For elite sports participants, indirect costs can be very high as injury might force their temporary or permanent withdrawal from competitive sports from which they earn an income.

A recent epidemiological study in the Latrobe Valley [13] found that injuries during sport and physical activity occur in 5% of participants over a 2-week period. These injuries had a significant public health impact with 27% of injured participants requiring treatment, 35% experiencing some effect on their quality of life and 36% having their further participation in sport and physical activity affected. Whilst this has enabled some identification of priority target areas and injury impacts, these preliminary estimates are limited because of the relatively small study size.

The rate at which significant injuries occurred was also different in different age groups [13]. As Table 5 showed children aged 5-14 years had the highest rate of significant injuries. In particular, children had the highest rate of injuries requiring treatment and affecting performance or participation in activity. This highlights the need to target children for injury prevention activities, especially if life-long participation in physical activity is desired. On the basis of injury frequency, sports injury prevention activities should be targeted to the 15-39 year old age group, as this group has the highest overall rate of injury. The 40+ age group is also important, as the greatest impact of sports injury on them is ongoing participation in physical activity.

7.3 Quality of life

The long-term outcomes of sports injuries are relatively undocumented. Psychological aspects of sports injury rehabilitation have been documented in elite athletes but not in cohorts of general sports participants. The few studies that have described the financial costs of sports injuries have typically not assessed how these injuries affect quality of life. Despite recent estimates that lost quality of life accounts for 81% of total sports injury costs [81], this has received relatively little attention in the literature.

A recent Australian study measured this impact [82]. A sample of 50 sports injury patients was recruited from patients presenting to 6 sports physicians based at 3 sports medicine clinics in Melbourne, Australia during June-August 1999. The eight dimensions of health-related quality of life and physical and mental health summary scores were calculated from the 36 items in the (short form 36) SF-36 according to the published guidelines using the US norms. The study concluded that sports injuries have a significant impact on general physical health and a less marked effect on mental health, especially in relation to vitality and social function. After six weeks the general physical and mental health of patients in the study were close to those of the general population, although pain levels were higher, which the authors considered as having the potential to dissuade patients from returning to physical activity. Physical recovery was linked to the seriousness of the injury and the age of the patient, with females reporting a greater physical impact from their injuries than did males with equivalent conditions.

Studies of larger cohorts of injured sports participants are needed to more accurately assess the nature and extent of the physical and mental health responses to sports injury. Future studies also need to compare the quality of life outcomes of injured patients to those of matched non-injured controls in order obtain a more accurate estimation of the responses to injury.
7.4 Potential for longer term costs

Finch and Owen [78] presented six major pathways through which sport and physical activity non-participation, participation and associated injuries can have both short and long term impacts on health. These pathways highlight the interrelationships between physical activity factors that can influence long term risk of chronic diseases and injury related factors which can have long term consequences in impairing people’s capacities to remain physically active.

A recent study explored the role that a current injury or disability played as a barrier towards being more physically active [83]. Data was extracted from an earlier population-based survey of physical activity conducted in Adelaide. In this population survey, 20% of the respondents listed a current injury or disability as one of their barriers to being more physically active. Just over half of these (54%) named the injury or disability barrier as their major barrier to increased physical activity. There was a significant association between age and reporting of current injury or disability as a barrier to increased levels of physical activity, with older people more likely to report the injury barrier. Similarly, overweight and obese individuals were significantly more likely to report the current injury or disability barrier, than were people who were of acceptable or low weight. There was also a significant linear relationship between current physical activity levels and the reporting of current injury or disability as a barrier to increased physical activity.

There is increasing concern that too much physical exercise or injuries resulting from participating in sport may lead to future osteoarthritis [84]. People with previously injured joints are at risk of developing osteoarthritis. Osteoarthritis can also develop because of surgical intervention or poor rehabilitation of a sports injury. A recent Australian review [84] concluded:

- individuals who have suffered sports injuries to joints, including the supporting structures and/or articular cartilage, may be susceptible to accelerated development of osteoarthritis;
- correct management and/or rehabilitation of sports injuries is critical for decreasing the risk of osteoarthritis;
- injured athletes should slowly return to sporting activities to ensure they do not place too much stress on their injured joint/s;
- further research into the causes of sport-related osteoarthritis, particularly focusing on safe levels of sports participation and the influence of sports injuries is required.

7.5 Summary of current status

The available estimates of the costs of sports injury are only, at best, very general indicators of the size of the problem. The figures are not comparable because of the different factors they consider and the different costs they include and exclude. They are not accurate because of the limitations of the existing data sources used to derive the figures but they do nevertheless indicate the size of the problem and the potential cost benefits to be gained from reducing it. Egger’s 1990 estimate remains the only available figure for the cost of sports injuries in Australia. The lack of a more accurate and up-to-date estimate of the cost of sports injuries hampers efforts to determine cost-benefit ratios for the introduction of sports injury prevention measures. Furthermore, it limits the leverage that can be applied to government to address the significant sports injury problem in this country. This is further influenced by the lack of accurate data on the occurrence and outcomes of sports injury. Reliable sports injury data would need to be compared to that for other injury types in order to determine priorities for further action. Nonetheless, the recognition of longer-term injury effects has implications for both sports injury prevention and promoting physical activity.
There are some differences in sports injury risk factors and their relative importance in various sports. For example, protective equipment to protect against impacts with other players is more important in contact or collision sports (for example, boxing, football) than in individual activities (for example, aerobics). Accordingly, the injury countermeasures recommended and likely to be effective for each sport are likely to be different.

A discussion session with a number of sporting bodies in 1995 [28] highlighted the need for up-to-date and relevant sports injury prevention information in a format that could be delivered to sporting organisations. The Victorian Government's Department of Sport and Recreation took up this challenge and funded the development of a series of sports injury countermeasure reviews (Appendix 5). Each of these critical reviews provides an evidence-based assessment of the efficacy of the commonly recommended interventions for popular sports in Australia. These reports also provide recommendations for further countermeasure development, research and implementation, including guidance for sports bodies. These reports have been widely disseminated to government agencies, local sporting bodies and sports participants across Australia. It is believed that these are being used to inform sports safety policy and to guide future research directions, at least in some sports.

The Victorian Injury Surveillance and Research program analyses and disseminates information about injuries presented to emergency departments [52]. Although not representative of all sports injuries, this data provides a useful source of information about severe sports injuries in Victoria. Furthermore, not all sports injuries can be identified through current coding systems, although it is hoped that this has recently improved with the new ICD-10 AM. However, it does have the advantage of being relatively timely. Data from this source was used to help inform the writing of recommendations for sports injury countermeasure development and implementation in 22 countermeasure review reports commissioned by (SRV) (Appendix 5).

An overview of cricket injury prevention measures was published in 1999 [85]. It concluded that further research was needed into the biomechanics of cricket actions, mechanisms of resultant injuries and clarification and identification of the role or various risk factors in injury causation. Cross-sectional studies, plus very few prospective studies, have identified clear associations between spine abnormalities and fast bowling techniques and training load.

Sherker and Cassell reviewed injury prevention methods for in-line skating injuries [86]. They concluded that there is good quality evidence for a protective effect of wrist guards and elbow pads for
in-line skaters. However, they also noted the lack of an evidence base for the other injury prevention methods and advocated further research, including fundamental biomechanics research, in this area.

The injury countermeasures for Australian Rules Football were critically reviewed by Gabbe and Finch [87]. The authors concluded that the only countermeasures where there was some evidence for effectiveness were mouthguards, thigh protectors and modified rules for children. Almost all research had been conducted in elite athletes and it is not known if the results of those studies relating to factors such as ground hardness are directly translatable to other levels of play.

When successful injury prevention measures and strategies are introduced their effect is evident in the short to medium term. This differentiates them from many other aspects of preventive health [5]. Sports injury is therefore an important demonstration area for public health where theories about prevention can be tested and results measured in the medium term.

Finch and Owen [78] have also argued that it should be a priority to bring together public health policy, strategy and research on physical activity with the newly developing body of epidemiological research on sport and physical activity injury. Implementation of public health policies to promote sport and physical activity requires health and fitness professionals, and individuals to make choices about the type, intensity and amount of activity they will promote or undertake. Currently, physical activity choices must largely be made in the absence of information on possible consequences.

If sports injuries are to be reduced, a comprehensive approach must be taken to define the nature and magnitude of the problem. An epidemiological description of the nature and incidence of sporting injuries, as described in this study, presents a starting point for this process. Comparison of these injury risks is useful for the identification of the areas most in need of specifically targeted preventive actions. Finally, this report demonstrates the importance of longitudinal, exposure-adjusted, sports injury studies. Data from such studies is needed to highlight variation in injury patterns over time and across sports.
8.1 Countermeasure studies

The only two areas where specific countermeasure evaluation has taken place in Australia, and been published since 1997, are broad-based education strategies and stretching before physical activity.

8.1.1 Education strategies

Following on from the work of ASIPT, the SportSafe Program developed nationally agreed risk management plans for sports and sporting facilities. The How to Become a SportSafe Club booklet was a direct initiative of this program and provides clubs with a checklist they can use to provide a safe environment to reduce the potential of injury and to meet legal duty of care. Two additional publications, How to Become a SportSafe Facility and How to Become a SportSafe School were also developed for publication but have not been widely disseminated.

The Safe Communities approach advocates the collection and analysis of local level data which is then provided to groups with a local interest in reducing injuries [88]. Such an approach was used in Sweden and used to evaluate a community-based program to prevent physical activity related injuries [88]. The program was derived from local data and involved the implementation of educational programs based on evidence-based promotion of fair play, supervision of inexperienced players and compulsory use of protective equipment. A quasi-experimental study design was used to evaluate the program in an intervention and control setting. Overall, the injury rate decreased in the study population but was not significantly different to that in the control area. Despite the authors' claim of evidence to show that the safe community approach was effective, the lack of a statistical difference between the two population groups would tend to negate this claim.

Another local study evaluated a campaign aimed at behaviour change in junior rugby and basketball players in relation to mouthguard use [89]. The health promotion campaign was developed by SMA (WA Branch) and consisted of education sessions, and distribution of promotional materials (leaflets, stickers, posters) with a health promotion message. A quasi-experimental design was used to evaluate the campaign and controls were players from a different sport, Australian Rules Football. Although the study demonstrated a positive benefit, the adequacy of the controls needs to be questioned.

An educational campaign aimed at achieving specific behaviour changes, to encourage squash players to wear protective eyewear is currently underway in Victoria and is expected to be reported on in late 2003 (Caroline Finch, personal communication). The implementation and evaluation is being funded by the NHMRC.

There can be a risk of injury associated with lightning during sports participation. Makdissi and Brukner recently presented practical recommendations to reduce the risk of lightning related injuries during outdoor sporting and recreational activities in Australia [90]. These authors chose to use the Medical Journal of Australia as the forum for disseminating these recommendations.
8.1.2 Stretching

Army recruits are a very physically active group whose physical training is an essential part of their work. As this physical training involves many of the activities associated with fitness, such activities are usually regarded in a sporting context. A recent randomised controlled trial (RCT) was conducted in 1800 Australian army recruits to determine whether or not pre-exercise stretching prevented lower limb injury [91]. An advantage of this study population is the ability to rigidly control the exercise program undertaken. In this case, it was a 12-week training program incorporating static stretching aimed at the six major leg muscle groups. This study could identify no preventive benefit for producing clinically relevant changes in exercise related injury risk.

A recent Australian systematic review considered the effects of stretching before and after exercise on muscle soreness and the risk of injury [92]. Only five studies reported in the literature had sufficient information to justify their inclusion in the review and all were rated as being of moderate quality only. The authors concluded that there was no significant benefit on muscle soreness and that there was no significant effect on injury risk. However, they noted that the findings in relation to injury risk could only be based on two Australian studies of army recruits and it would be necessary to determine whether these findings could be generalised to other sporting activities.

8.1.3 Protective equipment

Two trials evaluating the effectiveness of protective equipment in Australian football and rugby union are either in progress or yet to be reported on.

A recent ecologic study compared protective equipment use in two contact sports – New Zealand rugby union and US collegiate football [93]. The authors concluded that mandating protective equipment is an effective strategy for reducing injury, however they were not able to analyse the impact of such regulations or protective equipment use on attitudes and both safety and player behaviours.

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1 The Australian Football Injury Prevention Project was a clustered randomised controlled trial (RCT) of the effectiveness of both headgear and custom-fitted mouthguards for the prevention of head, neck and dental injuries in community Australian football. The trial was conducted in community Australian football players during the 2001 playing season. The results are expected to be released in late 2003. (Caroline Finch, personal communication)

2 The IRB Trial is a trial of two forms of protective headgear for the prevention of head injuries in community level rugby union players. The RCT is being conducted over the 2002 and 2003 playing seasons. Findings are expected to be released in 2004. (Andrew McIntosh, personal communication).
8.2 The need for evaluation of injury countermeasures

As previously acknowledged by both NIPAC and the NHMRC, the evaluation of the effectiveness of many existing injury countermeasures is urgently required. Many measures widely introduced and generally believed to reduce the risk of injury have not been evaluated. Where evaluations have taken place their findings have sometimes proved inconclusive, or even suggest that the measures are ineffective or counterproductive [3, 5]. The major weaknesses of the evaluation studies include:

- they are based on small and often non-representative samples;
- they have often been based on participant recall over long periods, which is known to be unreliable;
- studies may not be well designed or controlled. This means that accurate comparisons are not possible between injuries sustained before the introduction of a specific measure and those sustained after its introduction;
- evaluations of equipment in particular are often conducted in laboratory conditions and these results cannot be directly extrapolated to real life conditions; and
- evaluations are often conducted on elite athletes and again, the results may not be transferable to the general population.

Due to competing priorities for funding, few RCTs have been conducted to evaluate the effectiveness of sports injury countermeasures despite clear recognition that they would provide the strongest evidence. Until evidence from such studies is available, some doubt will remain about the efficacy of many of the countermeasures now routinely advocated and adopted. Incontrovertible evidence of the benefits of specific countermeasures would do much to encourage their implementation by sports medicine and sports science professionals. It would also lend weight to moves towards their mandatory introduction by sports organisations and others. In cases where such studies showed countermeasures to be ineffective, other approaches could then be developed to achieve the results that these studies were designed to achieve. Rigorous assessment and evaluation of existing injury countermeasures, which have not been subject to the scrutiny of randomised control trials, is an urgent priority in most sports and physical activities.

A group of Finnish sports medicine researchers, recently reviewed the published clinical trials relating to sports injury countermeasures [94]. At the time of their review, they could only identify 16 published RCTs relating to the prevention of sports injuries. The classical thinking is that the best scientific evidence for demonstrating effectiveness of an intervention is a well-designed RCT. On the basis of their examination of these RCTs, they concluded that the available evidence shows that [94]:

- a multifactorial injury prevention program can prevent general injuries (in soccer);
- ankle disc training, combined with a thorough warm-up can prevent general injuries (in European handball);
● ankle injuries can be prevented by ankle supports (in high risk sports such as soccer and basketball);

● stress fractures of the lower limb can be prevented by the use of shock-absorbing footwear insoles.

Cassell and Clapperton reviewed the international literature relating to the effectiveness of sports injury prevention measures and summarised it as shown in Table 8: [95]

Table 8: The effectiveness of sports injury countermeasures
(Adapted from Cassell et al, 2002)

<table>
<thead>
<tr>
<th>Level of evidence</th>
<th>Prevention measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good evidence for effectiveness</td>
<td>● the use of semi-rigid orthoses or air cast braces to reduce ankle ligament injuries in high risk sports</td>
</tr>
<tr>
<td>Evidence for effectiveness is promising</td>
<td>● a multi-factorial program in soccer (including education, training, protective equipment, ankle taping, controlled rehabilitation, etc.)</td>
</tr>
<tr>
<td></td>
<td>● regular warm-up and balance board training in European handball</td>
</tr>
<tr>
<td>Some support from non-randomised controlled studies</td>
<td>● proprioceptive ankle disc training for the reduction of ACL injuries in male soccer players</td>
</tr>
<tr>
<td></td>
<td>● standardised training program in safe landing technique to reduce ACL injuries in skiers</td>
</tr>
<tr>
<td></td>
<td>● plyometric (jump) training to reduce knee injuries in female athletes</td>
</tr>
<tr>
<td>Some support from non-randomised studies</td>
<td>● adjustment of ski bindings for the reduction of lower extremity injury in skiers</td>
</tr>
<tr>
<td></td>
<td>● wearing of wrist guards and elbow pads to prevent upper extremity injury in in-line skating</td>
</tr>
</tbody>
</table>

8.3 Summary of current status

International studies are beginning to provide strong evidence for the effectiveness of ankle supports and balance board training for preventing ankle injuries. This evidence should be used in Australia to inform prevention in applicable Australian sports.

Protective equipment is a popular strategy but its effectiveness has largely not been demonstrated in the field. Some major trials of the effectiveness of protective equipment are currently in progress in Australia.

There have been very few studies evaluating sports injury countermeasures both nationally and internationally. This is one of the major gaps in sports injury knowledge currently. This lack of information seriously limits the provision of evidence-based injury prevention guidelines for sports bodies, participants and parents. Considerable effort will need to be given towards addressing this major information gap if significant gains in sports injury prevention are to be reached over the next decade.
The implementation of safety strategies and risk management approaches

The previous chapter discussed the emerging evidence for the effectiveness of injury prevention measures in sport. The existence of effective injury prevention strategies, alone, will not reduce injuries. Irrespective of how well designed a prevention measure is, if not widely available, not implemented or implemented incorrectly, it will not make participation safe. It is therefore important that the motivators and barriers to optimally implementing injury prevention strategies be identified. Barriers to safety improvements can be both at a structural (that is, sporting club level) or personal (at an individual level).

The National Sports Safety Framework [6], was developed to provide a foundation for the future direction for sports injury prevention in Australia. In that report, guidelines were given for the provision of sport in the safest possible environment. The national framework articulated four inter-related tiers for the delivery of sports injury prevention activities:

- national and lead agencies,
- sports clubs/organisations,
- sports facilities,
- individuals.

There is no single documentation source describing the specific injury prevention measures implemented at the national and lead agencies level. However, many lead agencies have funded many safety initiatives and research projects (Appendix 2). The ASC is working very closely with National Sporting Organisations to help them improve their governance and management structures, particularly in areas concerned with risk management and insurance.

Since 1997, some considerable attention has been given towards identifying and understanding the implementation of safety strategies by sporting clubs and, to a lesser degree, sports facilities. Sports safety plans were suggested in the National Sports Safety Framework as a means of providing a structured approach to safety measure implementation [6]. Formal risk management plans were also advocated by NIPAC as the best buy in injury prevention in the sporting context [4]. Sporting clubs and associations are in the unique position of being able to implement risk management and sports safety plans for the benefit of a large number of sporting participants at the same time. However, while it is known that a large number of injury prevention measures have been developed for implementation at sporting clubs, the extent to which clubs organise, undertake, provide or adhere to these best practice guidelines and recommendations is largely unknown. This chapter summarises recent Australian research both in terms of risk management plans and specific strategies contained within such plans.
9.1 Adoption of risk management / sports safety plans

In 1999, NIPAC released a report on the best buys for injury prevention in Australia [4]. The aim of the report was to detail the areas which offer the best opportunities for investment in injury prevention based on factors such as achievability, cost-effectiveness and desirability of injury prevention interventions. The NIPAC advocated the development and implementation of risk management plans for the sports and leisure-related injury domain. It was suggested that such plans would be useful for implementing new injury countermeasures when they arise. It is important that the development of a risk management plan should be done so with consultation with the specific sport, using proven countermeasures and current best practices along with injury data collection and reviews of injury data [4].

A recent study from the UK has showed how application of risk based assessment processes can identify significant sources of injury and hence inform prevention strategies [96].

Sporting clubs' willingness or ability to implement new or to alter existing safety practices is likely to vary across different sports because of different levels of funding, infrastructure, knowledge and awareness. It is therefore important that specific information about the motivators and barriers to implementing sports safety in different sports is determined. Furthermore, injury prevention strategies and recommendations for sporting participants need to be based on knowledge of the current situation in the sporting clubs that will be expected or required to implement them.

In an effort to provide information about the level of knowledge of injury prevention, and current practices of sporting clubs and centres [97], a survey was conducted in one area of Melbourne in 1995 [97]. This survey found that about 50% of all sporting clubs/centres did not have a policy regarding the health and welfare of participants as an important goal. With regard to infectious disease prevention, only 36% adhered to the SMA Guidelines. Over the past two years, a further four sport-specific reports [98-101] and two Honours theses [102, 103] have also reported sporting clubs' injury prevention activities.

A large scale project was conducted by Donaldson and his colleagues in the Northern Beaches and the Hornsby-Ryde-Ku-King-Gai region of Northern Sydney [98-101]. A sports safety audit tool was extensively pilot tested and validated. This tool was administered in the winter season in 2002 in 20 rugby league, 35 rugby union, 49 soccer and 59 netball clubs within the region. This validated sports safety questionnaire was administered at a face-to-face interview with either a board member or trainer from the club.

In 2001, a survey of clubs from the largest metropolitan Australian Rules Football Community League was undertaken using the same validated audit tool. Interviews were conducted with the presidents of 32 clubs [103]. The City of Hume study which comprised of both urban and semi-rural communities [97] and the exploratory study by Casey was conducted in junior rural Victorian football and netball clubs [102].

Overall, the published studies have found the number of clubs reporting having "a comprehensive sports safety/risk management policy to address all aspects of injury prevention," to be low (mean: 41%; range: 0-71%) (Figure 3). Almost 70% of clubs overall reported having an emergency action policy in the event of a severe injury (mean: 69%; range: 0-91%). There was great variability in the proportion of clubs reporting having a policy for the management of head injuries/concussion (0 - 94%).
Guidelines on how a sporting club can become a ‘Sportsafe Club’ have been published [104]. These guidelines were developed by SMA to provide assistance to sports associations and clubs to implement sport safety practices. There are strong links with the National Sport Safety Framework [6]. The SportSafe Club publication was distributed through SMA to sports associations and clubs. In summary, the guidelines were developed to assist sporting organisations to proceed with the SportSafe recommendations of which they may not be aware. It was argued that guidelines such as these support the transition from the collation and understanding of the available information to the assist with the actual adoption of safety policies. The booklet included a Sports Safety Checklist as a step by step approach to planning for sport safety [104]. A limitation of the information within the publication is that it has not always been clear for sports bodies to know what to do with the information or how to address issues raised in the checklist. Across the country, SMA has coordinated workshops to explain the booklet to clubs. However, the implementation and impact of this potentially useful information resource has not been evaluated.

Otago and Brown described an approach to the application of a risk management plan [105]. Netball clubs participating in the Central Highlands Netball Region in Rural Victoria were involved in the project whereby GPs were used as facilitators of the training program aimed for coaches and administrators. A ‘train the trainer’ approach for GPs incorporating early intervention, injury surveillance and related sports safety issues was undertaken. As part of the project a sport environment safety audit and an education program, injury prevention and risk management plan were developed for the GPs and the wider community [105]. The plan to involve GPs as facilitators to a sport safety project is an original approach. There are potential significant benefits from a holistic approach involving facilitators, who can directly influence the safety practices of others. However, the ability of GPs to have an effect on safety practices of sporting clubs, in their context as doctors, has not yet been evaluated but is worthy of further attention. The results of this approach have not been published to date.

Figure 3. Proportion of club respondents reporting broad policies on injury prevention
If risk management plans really are the best buy for sports safety gains, as suggested by NIPAC [4], the question arises as to why are they not being implemented? One of the best motivators for clubs to introduce risk management plans over recent times has been insurance imperatives and increased potential third party legal liabilities. However, risk management plans in response to the insurance crisis more commonly reflect legal risk (i.e. against a suit against a sporting body) rather than injury risk. There is potential to combine both injury reduction and legal liability reduction strategies together and this needs to be explored.

Hughes, from IEA Sport Insurance, states that "unless they (i.e. the sports bodies) can demonstrate best management practices, no third party is going to want to share in their risk exposures" [106]. In another forum, he argues that the cost of liability insurance has become such an issue because of the claims that are being made [106]. This should be a strong incentive for sports bodies to implement safety initiatives.

According to Hughes, the sports industry insurance sector believes the critical components required in sport addressing risk must include [107]:

- an effective management infrastructure which is implemented and maintained;
- injury data which is collected and utilised to upgrade awareness and formulate preventative campaigns.

He goes on to argue that the foremost purpose of public sporting clubs is participation, at the least cost to participants. Restricted budgets act as a real barrier to risk management plans in many different sports in Australia [107].

Sports injury risk perception is also a barrier to the wide adoption of these safety policies. As Casey reports [102], football and netball key informants expected injuries to occur to participants. Whilst not all injuries are avoidable, many are preventable. Until sports injuries are thought to be preventable, the number and quality of operational risk management policies will not change from the current situation.

The Victorian Health Promotion Foundation commissioned a project to explore the relationship between parents and the health practices adopted by the junior sporting clubs with which their children were involved [108]. The major concern of parents was attention to the health and safety of their children, particularly safety, but many did not know what the club’s policy was on this. There tended to be an inherent belief that the coach was responsible for health and safety issues, or for alerting the club management should there be any issues, but few parents actually checked that this was the case.

The results presented in this Chapter suggest that clubs require information and assistance in all areas of developing and adopting a risk management policy: from the development, implementation through to monitoring. Anecdotally, most clubs would be pleased to be assisted with information, and training of important safety issues for their given sport and club. It would seem that the How to Become a SportSafe Club guidelines that were intended to be disseminated to the grass roots of sport (i.e. the clubs) have either not been effective or not widely disseminated. There is no information about where the resource has been disseminated or an evaluation of its impact. Lead agencies and governing sports bodies have a requirement to feedback into sport at the grass roots level, but also to assist in the transition of descriptive data to change the current situation of safety in sport. Safety in sport is the responsibility of all sporting agencies. However, direction is required.
9.2 Personnel, training and education

Accredited coaching and sports trainer personnel can contribute to sports safety through limiting training mistakes and through knowledge of appropriate injury prevention and management techniques. In the six studies of countermeasure implementation, a variety of results were found across sports (Figure 4). Overall, almost two-thirds of clubs reported having a policy on the qualifications of coaches (64%) and a similar number (65%) reported having a policy on the use of accredited sports trainers. The ability to have qualified coaching staff is assisted by organisations such as the National Coaching Accreditation Scheme. More than half of the sports clubs/centres (59%) surveyed in the City of Hume, reported that their sport participated in the National Coaching Accreditation Scheme [97]. The extent of their training or qualifications however is not known. The heavy reliance on volunteers in these sporting organisations may hinder the further development of qualified coaches and trainers.

Figure 4. Proportion of respondents reporting that their clubs had policies on the qualifications of coaches and sports trainers

A study published in 2002, surveyed 103 elite junior Australian Rules Football players to investigate the safety practices at various club levels of this football code [109]. Local club coaches were perceived by the junior players to provide more support to injured players than Victorian Football League (VFL) U18 coaches or school coaches. However, administrators at VFL U18 clubs were perceived to be more supportive than both local club and school administrators. Nearly all (90%) surveyed players believed that their VFL U18 clubs ranked game safety highly compared to only 73% of local clubs and 53% of schools. In all three football contexts, safety in matches was perceived to be ranked more highly than safety in training sessions [109]. A limitation of this information was that it was self-reported and the differences in perceptions across delivery of the sport were not validated.
Whilst having a committee or coordinator specifically responsible for sports safety does not in itself prevent injuries, it shows that sports safety is a priority for clubs, regardless of the level of play. The overall average proportion of clubs reporting having a sports safety committee or coordinator was low, at only 27% (Figure 5). A greater proportion of the clubs overall reported regularly reviewing their sports safety policies (45%).

Proportion of respondents reporting having a sports safety committee and regularly reviewing safety policies

The formal training of volunteers in these sporting clubs is widely promoted as a safety initiative. Suggestions that this group of people should be targeted to not only raise safety awareness, but also to provide safety education in their particular sport have been made [97, 103]. However, there is an issue of deciding whether the responsible person also has the capacity to direct and apply this at each individual sporting level.

The NSW club studies of the safety policies and practices at sporting clubs has led to specific recommendations for individual sports at each level of the sporting organisation from the governing body and regional associations through to the individual sporting club [98-101]. To assist in the widely reported recommendation of education and training of club personnel, a register of coaches, first aid providers and club-based officials recommended to be maintained. Preferably, this would include information regarding qualifications, re-accreditation requirements and prohibited persons screening. In addition, it is the individual clubs’ responsibility to ensure that all coaches and first aid providers are informed about, have access to, and are encouraged and supported to attend relevant training. Having all staff qualified is one step, however all coaches must hold relevant qualifications appropriate for the level of instruction and care that they are required to provide. Regional associations and governing bodies can take part in this particular safety issue in areas of awareness, access, information, training, resources, rules and policy development.

The collaborative, volunteer nature of sports clubs management has several associated barriers to risk management policies in these clubs [97-102, 104]. Foremost, their volunteered time is highly prioritised to getting the sport played. There is also the issue...
of whether or not volunteers have the necessary knowledge and/or expertise to direct and develop safety initiatives. The issue of volunteers is even more of a problem in rural areas [102]. Many clubs also lacked the knowledge and abilities to be able to perform the duties that a risk management policy would demand. Committees and personnel have designated roles in a specific sporting organisation, and at most clubs, no personnel are assigned to the duties of ‘risk management’.  

9.3 Equipment

Sporting equipment is an essential part of any sport. Continual technological advancements result in developing aspects of sporting equipment performance and safety. However this development is at a cost. At the club and organisation level it is paramount to keep up to date with appropriate equipment, which is well maintained and used in the correct manner. Club personnel require considerable knowledge of both the playing and protective features of equipment used in each sport. The purchase of equipment is often balanced between the cost and safety as well as performance attributes. A factor found to hinder the use of specific protective equipment is the availability of it, to both the sporting club operators and players. Little is known regarding the use of protective equipment at the club level in Australia. However, Figure 3 displays results of surveys of sporting clubs that have a policy on inspection of the playing surfaces.

Overall, more than 75% of clubs had a policy on inspecting the playing surface prior to games (range: 50-100%) (Figure 6). A smaller number reported this also being the case for inspections prior to training (46%; range 25-63%). Differences between safety practices at competition and training is something that needs to be further investigated, as injuries in training can still occur.

Sporting bodies should ensure that all safety issues are addressed well at training as well as matches. The potentially reduced risk of injury during training compared to matches needs to be analysed on a sport by sport basis. The nature of training versus matches may differ - for example, less physical contact and more closed skill practice

Figure 6. Proportion of respondents reporting the clubs have a policy on inspecting the playing surface prior to training and games

<table>
<thead>
<tr>
<th>Study of sports safety implementation</th>
<th>Proportion of respondents (percentage) reporting a policy on the inspections of the playing surface</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australian rules football (103)</td>
<td>Games: 103, Training: 100</td>
</tr>
<tr>
<td>Australian rules football (102)</td>
<td>Games: 102, Training: 101</td>
</tr>
<tr>
<td>Netball (102)</td>
<td>Games: 102, Training: 100</td>
</tr>
<tr>
<td>Netball (98)</td>
<td>Games: 98, Training: 99</td>
</tr>
<tr>
<td>Rugby union (100)</td>
<td>Games: 100, Training: 99</td>
</tr>
<tr>
<td>Rugby league (99)</td>
<td>Games: 99, Training: 98</td>
</tr>
<tr>
<td>Soccer (101)</td>
<td>Games: 101, Training: 100</td>
</tr>
<tr>
<td>Various sports (97)*</td>
<td>Games: 97, Training: 95</td>
</tr>
</tbody>
</table>

Proportion of respondents reporting a policy on the inspections of the playing surface

Games | Training
at training. On the other hand, the lower proportion of inspection of playing surfaces at training may be related to the volunteer aspect. The volunteers may be more available or more often present during matches. From the research at the sporting club and organisational level, there is little information and recommendations on the use of protective equipment. From a research perspective, to date this subject has been prioritised at the individual level.

9.4 Summary of current status

Sport safety plans at the sports club, organisation and facility level have received attention over the past five years. There is also, quite a considerable amount of descriptive information, with recommendations on personnel, training and education for several sports at this level. However, it would seem that many of the recommendations in the National Sports Safety Framework have not been implemented.

There is currently no information on whether clubs, organisations and facilities are ensuring that their participants are using and maintaining appropriate playing equipment. There is no information about their provision and use of protective equipment or whether they are currently observing and recording injuries. There has been no investigation into their capacity to describe the injuries that occur. Individual club records could assist injury prevention research while helping the club to become aware of the injuries that are occurring.

Many sports associations direct safety rules regarding qualifications and training of personnel, and ensure that most local clubs adhere to these rules. Sports bodies can therefore influence the safety policies adopted by their clubs. Governing bodies should delegate personnel to safety policies and practices amongst their clubs. This is not specific to training and education of personnel, but applies to all safety issues in sport. At the club level, where possible a club person should be appointed responsibility for all safety issues. However, the likelihood of this occurring is uncertain.

For widespread injury prevention at sports clubs, organisations and facilities, it is imperative to collect sport specific, descriptive data about the injury and its circumstances. Recommendations then need to be fed back to the appropriate personnel at the club level in each specific sport. Generic data collection and recommendations will not aid widespread sports injury prevention. Donaldson et al have effectively developed and applied survey methods to four individual team sports [98-101, 110]. This has enabled sport specific recommendations to be provided.

Sporting clubs in Australia vary considerably in the extent to which they consider or implement risk management policies, even in the few sports in which this has been formally investigated. Furthermore, only a small proportion of clubs apply risk management policies, as compared to emergency action policies or head injury management policies. There are various barriers to the development, implementation and monitoring of these plans. The collaborative, volunteer nature of sports clubs management has several inherent barriers to risk management policies in these clubs [97-102, 104]. Foremost, their volunteered time is highly prioritised to getting the sport played. There is also the issue of whether or not volunteers have the necessary knowledge and/or expertise to direct and develop safety initiatives. The issue of volunteers is even more of a problem in rural areas [102]. Many clubs also lacked the knowledge and abilities to perform the duties that a risk management policy would demand. Committees and personnel have designated roles in a specific sporting organisation, and at most clubs no personnel are assigned to the duties of ‘risk management’.
Chapter 10

Individual adoption of, and barriers towards sports injury prevention initiatives in Australia

The majority of sports injury prevention research in Australia over the past five years has focused on the level of the participant. In the main, this has been restricted to studies of protective equipment use. The use of protective equipment and the factors relating to its use in Australia has been reported for squash, rugby union, Australian Rules Football and netball. This Chapter summarises current understanding about Australian participants’ specific behaviours, knowledge and attitudes associated with the use of specific protective equipment. Whilst a warm-up is not equipment, the injury prevention practices and barriers of this at the participant level in golf and netball have also recently been addressed are also summarised.

10.1 Protective equipment behaviours

In a survey of 140 under-15 schoolboy rugby union players, 76% of players reportedly always wore protective equipment [111]. In this sport, mouthguards and protective headgear were the protective equipment most commonly worn. Those players who had recently sustained a head/neck injury were more likely to report previous injury as a motivating factor for wearing headgear, than those without recent head/neck injury. The main reasons players stated as to why they did not wear headgear was because of discomfort and heat [111]. Other common reasons for not wearing headgear included ‘I don’t like to’ (39%) and ‘I don’t need to’ (25%) [111]. Safety was the major motivator for wearing protective headgear, with 54% of players reporting that they ‘feel safer when I wear headgear’ and a further 42% reporting they the ‘don’t want to get an injury’ [111]. Approximately half (55%) of headgear users believe that wearing headgear could prevent head injury [111].

In a 1995 study of 197 squash players in the eastern suburbs of Melbourne, 9% reported wearing protective eyewear [112]. However, fewer than 2% of players wore appropriate protective eyewear (that is, eyewear that meets the Australian Standard for protection). The most commonly reported reasons for using protective eyewear were ‘I don’t want to get an injury’ (65%) and ‘I don’t want to be blinded’ (41%) [112]. Amongst players reporting not wearing protective eyewear, 13% reported that eyewear was too uncomfortable and 12% believed that it adversely affected their vision [112]. In this sample, 18% of non-eyewear users could not give a particular reason for not wearing the equipment [112].
As a follow-up to this study, a second squash eyewear use survey was conducted in Melbourne in 2000 [113]. Of the 303 surveyed adult players, 19% reported wearing protective eyewear; the proportion of players wearing appropriate protective eyewear was only 9%. Either personally having an eye injury or knowing someone who had were the main reasons for wearing protective eyewear [113]. Having knowledge of the risk of injury was the next main most commonly stated reason (34%) for wearing protective eyewear. ‘I do not want to’ was the most common reason for not wearing eyewear (40%). Restriction of vision (34%) and too uncomfortable (26%) were the next two common reasons. Although, 58% of non-users stated that they had never tried using such eyewear.

The only Australian published studies of protective equipment behaviours of players are in rugby and squash. Even though the equipment in these differs, there have been some common factors identified that relate to the use of protective equipment. It is not known whether these influencing factors relate to other forms of protective equipment in other sports. Those that do not wear it in both rugby and squash have raised concerns about the comfort of protective equipment. This is even though, in squash at least, many of these players have never tried using the protective equipment. In rugby, discomfort was not a concern amongst wearers. The major motivator for wearing protective equipment in these two sports, is direct injury experience and safety concerns.

10.2 Attitudes towards protective equipment

The current attitudes and beliefs of sporting participants should be taken into account in the design of protective equipment and for other safety initiatives to ensure that the measure has the desired outcome and greatest possible rates of use. Given the importance of individual safety attitudes and beliefs in influencing the use of protective equipment (and probably other injury prevention strategies), further research into identifying personal motivators and barriers to adoption is warranted.

Whilst not addressing a specific injury prevention measure, a study with 103 players in the sub-elite VFL competition reported on the footballers attitudes and beliefs to safety in general [109]. This study found that only 6% of players believed that it was safe to play with injuries. Seventy percent of players believed that players should be fully rehabilitated before playing football again after an injury and 58% said they would be willing to play when injured [109]. This indicates some adverse attitudes and beliefs towards safety in this group of football players. Although there were a large number of players willing to risk playing with an injury, the majority thought that they should be fully rehabilitated before playing.

An Australian squash players study assessed changes in the attitudes towards protective eyewear over a ten year period [114]. It concluded that a lack of knowledge about the risks of eye injury in the sport and of appropriate protection was apparent. Self reported eyewear use ranged from 10% in 1989, to 9% in 1995 and 19% in 2000. However, only 8%, 2% and 9% of players respectively wore appropriate
eyewear. This would suggest that there have not been major changes in players’ attitudes towards the risk of eye injuries since 1989. Nonetheless, there was significantly more support for general protective eyewear use in 2000 compared to the 1995 survey. Most players in each of the three studies indicated that they would not stop playing squash if protective eyewear was made compulsory, even though they were not in favour of this regulation [114].

10.3 Warm-up

Another individual injury prevention countermeasure – warm-up procedures – have been investigated for golf by Fradkin et al [115] and netball by Hume and Steele [12]. Fradkin et al [115] aimed to determine the proportion of amateur golfers who warm-up and to determine their specific warm-up behaviours. Of 1040 observed golfers, 54% performed some form of warm-up. Mostly these practices comprised of air swings on or before the tee. Very few players were seen performing static stretches, and no player was observed undertaking aerobic activities before playing. Although warm-up procedures performed before attending the driving range, or out of the observer’s view are excluded in this study. The authors concluded that the limited warm-up procedure of golfers is unlikely to be adequate to achieve injury prevention benefits [115]. The authors state that whilst evidence for the benefits of warm-up is lacking, there is wide support that those players, who do not participate in warm-up procedures, may increase their risk of injury.

Hume and Steele surveyed state championship netball players and did not specifically observe or survey warm-up procedures [12]. Although most of the state championship netball players paid attention to advice pertaining to warm-up, the occurrence of injuries during warm-up and cool-down suggested that activities performed during these periods may be inappropriate. Of the injured players 5% reportedly failed to warm-up before commencing a match.

In relation to warm-up procedures in golf, Fradkin et al [115] advocate the development of appropriate warm-up routines with formal evaluation of the specific injury prevention as well as performance benefits. Information on knowledge and attitudes towards warm-up also needs to be determined. Subsequent education strategies can then be employed to golfers concerning the benefits of warm-up and information on how to perform an adequate warm-up procedure.
10.4 Summary of current status

Protective equipment use and the factors relating to its use has been the subject for some recent Australian sports injury research, particularly in squash and rugby union. Nonetheless, the use of, and factors relating to the use of protective equipment in most Australian sports is not known. Furthermore, whether or not the equipment that is being used in sports is suitably protective, fits accordingly, and maintained properly is largely unknown.

From the attitudes of players who do and do not wear headgear when playing rugby, Finch et al [111] recommended that any protective equipment needs to meet the expectations of players with regard to comfort, design, look, as well as protection. The need to increase players' knowledge about, and awareness of injury as well as the benefits of headgear was expressed. One possible means is to increase the use of headgear during training sessions. Educating parents as well as junior players in this instance is suggested, because of the strong influence that parents were shown to have for headgear use in this study.

Before efforts to promote protective eyewear can be effectively developed, it is important to determine players' current behaviours, knowledge and attitudes associated with protective equipment and injury risk. As Finch et al [97] suggest, the negative attitudes and beliefs of players towards the use of protective equipment need to be addressed. The wearing of protective equipment is one of many factors that influence safety behaviour. Simply considering one factor, such as education for increased knowledge will not be sufficient for behaviour change.

Protective eyewear for squash is currently not readily available to players, and therefore expecting players to wear such equipment is unreasonable. As Eime et al [113] point out, it is imperative that all players are made aware that only Standards Approved polycarbonate lens eyewear ensures safety. The proportion of players wearing inappropriate eyewear is a concern. At present, a lack of knowledge about the risks of eye injury and of what eyewear is suitably protective may contribute to the low rates of protective eyewear use. Education of the risk of injury is also an important issue that requires addressing. Specifically, in this case a multifaceted approach utilising a joint effort of the sporting organisation, eyewear manufacturers and distributors as well as player associations is required to influence players' behaviours.
Chapter 11

Conclusions

This Report has provided an update of sports safety initiatives that have been conducted in Australia since the launch of the National Sports Safety Framework in 1997. Because of the recent activities in the sports injury area, we now have a much better understanding of some aspects of sports injury and sports safety than at the time of National Health Goals and Targets initiative in 1994 and the setting of this national Framework. There are still many aspects of sports safety where our knowledge is still quite limited and other areas where it is practically non-existent.

The sports injury literature is replete with papers based on poor case definition, non-representative samples, little or no detail on data collection methods, a lack of appropriate exposure data and poor reporting of data. It is difficult to collate this information for a coherent picture of the sports injury problem, let alone identify and quantify risk. It will not be possible to directly compare different studies until there are standard definitions and methodologies. Consistent methodologies must be developed and adopted by all sports injury epidemiologists so that the studies can be repeated by two different research groups on the same population, or in similar populations, making it possible to compare and combine results.

Table 9 provides a summary of the current status of sports injury knowledge, as at the end of 2002, and compares this to NIPAC's earlier assessment in 1999. Since the late 1990s, there has been an increase in knowledge about:

- the burden/cost of sports injuries;
- some potential risk factors (though this knowledge is still quite limited);
- implementation of interventions; and
- barriers and motivators associated with the uptake of interventions.

The only area where there is good evidence available is in the description of the nature of sports injuries. There continues to be no evidence about what interventions have been formally trialled, the effectiveness of such interventions or the cost-benefit analyses associated with their implementation.
The following sections summarise the key information gaps in each of these areas and identifies what we do know, based on the material presented in this report.

Table 9: **Status of available evidence on sport injuries in Australia**

<table>
<thead>
<tr>
<th>Type of evidence</th>
<th>According to NIPAC in 1999</th>
<th>Update as at end of 2002</th>
</tr>
</thead>
<tbody>
<tr>
<td>Injury data</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Incidence</td>
<td>+/-</td>
<td>+/-</td>
</tr>
<tr>
<td>Burden/cost</td>
<td>–</td>
<td>+/-</td>
</tr>
<tr>
<td>Nature of injuries</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Countermeasure development and evaluation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Identification of risk factors</td>
<td>–</td>
<td>+/-</td>
</tr>
<tr>
<td>Identification of solutions</td>
<td>+/-</td>
<td>+/-</td>
</tr>
<tr>
<td>Interventions trialled</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Evidence of effectiveness</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Implementation of countermeasures</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost benefit analysis</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Implementation of interventions</td>
<td>not considered</td>
<td>+/-</td>
</tr>
<tr>
<td>Identifying and addressing barriers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Identification of barriers/motivators</td>
<td>not considered</td>
<td>+/-</td>
</tr>
</tbody>
</table>

Key:
- + evidence available;
- – evidence not available; and
- +/- evidence limited in some areas.

The following sections summarise the key information gaps in each of these areas and identifies what we do know, based on the material presented in this report.
11.1 Injury data

Reasonably Good Understanding

Based on the best available evidence in Australia, at this time we can say with some confidence that:

- most sports injuries are minor in terms of medical care;
- catastrophic injuries are relatively rare;
- the incidence of sports injury is significant, but is underestimated in currently available figures;
- the costs of sports injury (direct and indirect) are substantial, but not quantified;
- the causes of injury are multi-factorial;
- particular groups, and participants in particular sports, are at high risk of injury;
- there is an elevated relative risk of injury in team ball sports, particularly the football codes and netball and basketball.

Limited Understanding

At this stage, there is only incomplete information about:

- the exact incidence and severity of sports injury;
- the pattern and causes of sports injuries in community participants;
- sports injury rates adjusted for exposure to injury (that is, by hours of participation);
- the extent to which sports injuries prevent or limit participation in sport and physical activity.

Minimal Understanding

Currently, there is minimal, or no information about:

- a reliable, and up-to-date, estimate of the magnitude of the direct and indirect costs of sports injury;
- secular trends in sports injury occurrence in Australia, or in local areas;
- the incidence of sports injuries across regions of Australia.

11.2 Countermeasure development and evaluation

Reasonably Good Understanding

Based on the best available evidence in Australia, at this time we can say with some confidence that:

- the causes of injury are multi-factorial;
- particular groups, and participants in particular sports, are at high risk of injury;
- many injuries could be prevented or controlled if suitable prevention methods are adopted.

Limited Understanding

At this stage, there is only incomplete information about:

- sports injury risks in elite versus non-elite participants;
- risk factors for injuries in community-level participants and how this risk differs across sports.

Minimal Understanding

Currently, there is minimal, or no information about:

- which interventions work and which do not work;
- the fundamental biomechanical mechanisms of injury - this information is needed to develop injury prevention measures.
11.3 Implementation of countermeasures

**Limited Understanding**

At this stage, there is only incomplete information about:

- the adoption of safety practices in some sporting club settings;
- health education strategies that have been implemented.

**Minimal Understanding**

Currently, there is minimal, or no information about:

- which interventions are widely adopted and why;
- the adoption of safety practices at sporting facilities (as opposed to through within the sporting club contexts);
- the effectiveness of broad-based health education strategies and sports safety messages;
- the cost/benefits of implemented interventions;
- which particular sports activities are associated with the greatest health benefits and least health costs. Walking is a major focus of public health strategy and current campaigns, but there is the potential to identify other safe forms of activity that can also usefully be promoted to different population subgroups.

11.4 Identifying and addressing barriers

**Limited Understanding**

At this stage, there is only incomplete information about:

- actual sports safety behaviours by both participants and those responsible for the delivery of safe sport;
- attitudes to safety and to safe sporting practices;
- the motivators for safety behaviours for targeting or influencing by implementation strategies.

**Minimal Understanding**

Currently, there is minimal, or no information about:

- perceptions of risk by participants.
References


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36. Irish, B., The role of insurance data for describing squash injuries, in School of Human Movement. Deakin University; Melbourne; 1999.


40. Grimmer, K., et al., Young people's participation in sports and recreational activities, and associated injuries. Sports Medicine Australia; South Australia; 1999.

48. Carter, A. and R. Muller, Patterns and causes of injuries during organised sporting activities in the Mackay Region (North Queensland) 1998-2000, in Reducing injuries in Mackay, North Queensland, R. Muller, Editor. School of Public Health and Tropical Medicine, James Cook University: Mackay/Whitsunday Safe Communities Project: 95-113.
49. Hanson, D., et al., Collection of NDS-IS Level 2 injury surveillance data in regional Queensland, in Reducing injuries in Mackay, North Queensland, R. Muller, Editor. 2002, School of Public Health and Tropical Medicine, James Cook University; Mackay/Whitsunday Safe Communities Project: 1-16.
51. Speed, H. and C. Finch, Shooting for basketball injury prevention - a review of the literature. School of Human Movement, Deakin University; Melbourne; 1998.
52. Ashby, K., et al., The 50th issue of HAZARD, a celebration of VISAR’s achievements. Monash University Accident Research Centre; Melbourne; 2002.


70. Gabbe, B., Risk factors for lower limb injuries at the community-level of Australian football. School of Physiotherapy, University of Melbourne; Melbourne; 2002.


102. Casey, M., Fostering safe sports participation by adolescents in rural communities. School of Health Sciences, Deakin University; Melbourne; 2001.


106. Hughes, R., This is a fine situation we have got ourselves into, in IEA Sport Monthly Update. 2001.


108. Victorian Health Promotion Foundation, Parents and health policies of sporting clubs research. Victorian Health Promotion Foundation; Melbourne; 2002.


Appendix 1:

Bibliography of published Australian sports injury prevention resources

This list summarises the broad range of sports injury and sports injury prevention resources published since 1997. This list includes research papers, formal research reports, informal reports, web items, books, etc.

The papers are listed separately in three different sections:

A) sport-specific papers;
B) injury type-specific papers;
C) study designs.

A) Listing according to studies in particular sport

Aerobics

Australian Rules Football
ELITE
Bennell K, Tully E and Harvey N. The relationship of hamstring and lumbar spine flexibility to hamstring injury in Australian Rules Football.

Donohue S. The playing habits and associated safety attitudes and beliefs of elite junior Australian footballers. Honours thesis. School of Health Sciences, Deakin University; Melbourne; 1999.


NON-ELITE


GENERAL (COVERS BOTH ELITE AND NON-ELITE)


Basketball

ELITE


NON-ELITE


Boxing


Cricket

ELITE


GENERAL (COVERS BOTH ELITE AND NON-ELITE)


Golf

AMATEUR

Fradkin A. Amateur golfers' attitudes, knowledge, and behaviours in relation to warming-up. Honours thesis. School of Health Sciences, Deakin University; Melbourne; 1999.


GENERAL (COVERS BOTH AMATEURS AND PROFESSIONALS)


**Gymnastics**

**GENERAL (COVERS BOTH ELITE AND NON-ELITE)**


**Hockey**

**NON-ELITE**


**In-Line skating**

**NON-ELITE**


**Horseriding**


**Little athletics**


**Military recruits**


Netball

ELITE


NON-ELITE


Rugby league

ELITE


NON-ELITE


GENERAL (COVERS BOTH ELITE AND NON-ELITE)


Rugby union

ELITE


NON-ELITE


NON-ELITE


GENERAL (COVERS BOTH ELITE AND NON-ELITE)


Rugby unspecified

NON-ELITE


Rotem T. Rugby football injury mechanism study - a report to the NSW Sporting Injuries Committee. NSW Sporting Injuries Committee; Sydney, October 2001.

Running

ELITE


Skiing

GENERAL


Snowboarding

GENERAL


Soccer

NON-ELITE


Squash

NON-ELITE


Eime R. Squash players' knowledge, attitudes and behaviours associated with the use of protective eyewear. Honours Thesis. School of Health Sciences. Deakin University; Melbourne; 2000.


Touch football


ACROSS SPORTS

(COVERS MORE THAN JUST ONE SPORT)


B) Listing according to injury types

Deaths

Head/Concussion injuries

Lower limb injuries
**Stress fractures**


**Abdominal injuries**


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**C) Listing according to the research or other methodologies used to collect injury data**

**Injury rates derived from coronial records**


**Injury rates derived from clinic/emergency department presentations**


**Injury rates - Injury surveillance systems**

Finch C, Cassell E, Stathakis V. The epidemiology of sports injuries in the Latrobe Valley. Research Report No. 103; Monash University Accident Research Centre; March; 1999.


Injury rates – Derived from medical coverage of sporting events


Injury rates – Derived from self-report surveys


Impacts of sports injuries


Methodology – Injury surveillance


Methodology – Biomechanical studies


Reviews


Prevention of sports injuries studies

Protective equipment use


Intervention studies


Review of counter measures


Risk factor studies


Rotem T. Rugby football injury mechanism study - a report to the NSW Sporting Injuries Committee. NSW Sporting Injuries Committee; Sydney; October 2001


Safety attitudes


Donohue S. The playing habits and associated safety attitudes and beliefs of elite junior Australian footballers. Honours thesis. School of Health Sciences. Deakin University; Melbourne; 1999.
Eime R. Squash players’ knowledge, attitudes and behaviours associated with the use of protective eyewear. Honours Thesis. School of Health Sciences, Deakin University; Melbourne; 2000.


Safety practices


Appendix 2:

Contributors to the publication

The following list acknowledges the individuals and organisations that contributed material to this report, in response to the emailed requests for information.

Mr John Anderson, Executive Officer, NSW Sporting Injuries Committee (NSW);
A/Prof Kim Bennell, A/Prof Peter Brukner, Dr Paul McCrory, Centre for Sports Medicine Research and Education, University of Melbourne (VIC);
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Ms Karen Cirovski, Commonwealth Department of Health and Ageing;
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Mr John Strahran, Victorian Health Promotion Foundation (VIC);
Mr Frank Wallner, Manager, Healthy Cities Illawarra Incorporated (NSW).

This report was prepared by Professor Caroline Finch for the Commonwealth Department of Health and Ageing. It draws heavily on an earlier report prepared for the Commonwealth Department of Health and Ageing by Sports Medicine Australia. Rochelle Eime and Tsharni Zazryn are thanked for their assistance with collating some of the information for this report.
Appendix 3:

Funding for sports safety activities in Australia, 1998-2002

Activities are broadly grouped into three areas:
- sports safety/health promotion initiatives;
- injury surveillance activities;
- research projects.

Under each heading, details are given of the team members, the title of the project, the source and amount of funding and the duration of the project. The projects are listed in chronological order from most recent to least recent.

The list only includes those projects that were totally related to sports injury. As the focus of this report is only on research that is directly related, or potentially related, to sports injury prevention or an understanding of the mechanisms of injury to inform the development of prevention strategies, projects related to the treatment or management of sports injuries have been excluded from this list. It is recognised that there have also been some other funded initiatives with broader objectives (for example, emergency department data collections) but these have also been omitted from this list. Some contributors provided information on projects relating to beach or water safety (for example, surf life saving or diving) or playground falls. As these are related to the water safety or child fall prevention strategies, rather than prevention in the context of organised sport, they have also been omitted from this list, unless they relate to organised sports activities. In addition, funding for student projects (for example, NHMRC and other PhD Scholarships) are excluded from this list. Details of these scholarships can be found in Appendix 4.

Sports safety / health promotion initiatives


INJURY SURVEILLANCE ACTIVITIES


Research projects

Gabbe B. Outcomes of major trauma and sports injuries. NHMRC Postdoctoral Research Fellowship. Department of Epidemiology and Preventive Medicine, Monash University, Melbourne (2003-2007).


Plaisted V, Otago L. Examining the uptake of injury prevention strategies in sport: assessing urban-rural differences using the transtheoretical model. ARC Small Grant (2002).


Lloyd D. Video analysis of knee injuries in the AFL competition. AFL Medical Officers Association (2001).


Finch C. The Australian football injury prevention project - player incentives. Strategic Research Funding, School of Health Sciences, Deakin University (2000).


Finch C. Aerobics injury countermeasure review. Funded by Sport and Recreation Victoria (1999).


McIntosh A, McCrory P. Controlled trial of helmet protection in Australian football and rugby. Football Australasia Grant. Royal Australian College of Surgeons (1999).


Appendix 4:
Australian student sports injury research projects, 1998-2002

Doctoral students

CURRENT
Rebecca Braham. The role of headgear and mouthguards for preventing football injuries. NHMRC Postgraduate scholarship, PhD, Monash University.
Rebecca Dennis. Lower back injuries in cricketers. PhD, Monash University.
Alex Donaldson. Community sports safety. DHSci, Deakin University.
Rochelle Eime. An evaluation of the protective eyewear regulation for squash players. NHMRC Postgraduate scholarship, PhD, Monash University, Melbourne.
Andrea Fradkin. Injury prevention and performance improvement benefits of warm-up in golfers. NHMRC Postgraduate scholarship, PhD, Monash University, Melbourne.
Alexandra McManus. Sports Injury Prevention: From research to policy and practice. NHMRC Public Health Doctoral Research Scholarship, PhD, University of Western Australia.
John Orchard. The relationship between ground conditions and injury in football. DM, University of Melbourne.
Natalie Saunders. Landing patterns in females: game vs laboratory. APA scholarship, PhD, University of Ballarat.
Tsharni Zazryn. A prospective cumulative study of brain injury in boxers. NHMRC postgraduate scholarship, PhD, Monash University, Melbourne.

COMPLETED
Thor Besier (2000). Examination of neuromuscular and biomechanical mechanisms of non-contact knee ligament injuries. PhD, University of Western Australia.

Masters students

CURRENT
Dimitri Diacogiorgis, Range of motion and its effect on the incidence of medial tibial stress syndrome. University of Ballarat.
C Meakin, Neuromuscular adaptations of the ankle with stability training. University of Western Australia.
Grant Mckechnie, The effects of massage on range of motion. University of Ballarat.
Jane Whitecross, Ankle stability tests in a healthy population. University of Ballarat.

COMPLETED
Belinda Gabbe (1999). The descriptive epidemiology of Australian football injuries presenting to sports medicine clinics. Deakin University, Melbourne.

Completed Honours projects


Stephen Donohue (1999). The playing habits and associated safety attitudes and beliefs of elite junior Australian footballers. Deakin University, Melbourne.


Appendix 5:

Australian sports injury countermeasure review reports

Funded by Sport and Recreation Victoria

AEROBICS *. Salmon J, Garnham A, Finch C. In step with aerobic dance injury prevention. School of Health Sciences, Deakin University; Melbourne; 2000.


BASEBALL. Finch C, Valuri G, McGrath A. Pitching injury prevention to baseballers and softballers: a review of the literature. Monash University Accident Research Centre; Melbourne; 1996.

BASKETBALL. Speed H, Finch C. Shooting for basketball injury prevention - a review of the literature. School of Human Movement, Deakin University; Melbourne; 1998.

CRICKET *. McGrath A, Finch C. Bowling cricket injuries over: a review of the literature. Monash University Accident Research Centre; Melbourne; 1996.


GYMNASTICS *. Daly R, Bass S, Finch C, Corral A. Balancing gymnastics and injury risk - a review of the literature. Deakin University, School of Human Movement; Melbourne; 1998.


NETBALL. McGrath A, Ozanne-Smith J. Attacking the goal of netball injury prevention: a review of the literature. Monash University Accident Research Centre; Melbourne; 1998.


RUNNING. McGrath A, Finch C. Running the race against injuries: a review of the literature. Monash University Accident Research Centre; Melbourne; 1996.


SOFTBALL. Finch C, Valuri G, McGrath A. Pitching injury prevention to baseballers and softballers: a review of the literature. Monash University Accident Research Centre; Melbourne; 1996.


TENNIS. Cassell E, McGrath A. Lobbing injury out of tennis: a review of the literature. Monash University Accident Research Centre; Melbourne; 1999.

Note: All reviews indicated with a * have also been published as peer-review journal papers (see sport-specific listing in Appendix 1).