

ROLLING INJURIES OUT OF
LAWN BOWLS:
A REVIEW OF THE LITERATURE



by

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Abstract:

Lawn bowls is a popular sport and leisure activity in Australia played by an estimated 75,000 to 80,000 Victorians. Health professionals recommend the sport to older people because it provides low impact, therapeutic exercise in a social and supportive atmosphere.

There are no comprehensive data on lawn bowls injuries. Data from hospital emergency department surveillance systems revealed that presentations for lawn bowls injuries are uncommon. This is possibly explained by the lower physical intensity of bowls compared with other sports and the likelihood that bowlers may seek treatment elsewhere (for example from General Practitioners, physiotherapists and chiropractors) or self treat their injuries.

In total there were 29 lawn bowls injury cases recorded on the new Victorian Emergency Minimum Dataset (VEMD) and the superseded Victorian Injury Surveillance System (VISS). Approximately three-quarters (76%) of the injured players were female, indicating they may be at higher risk of injury because ABS sports participation data indicate they comprise only 39% of participants in lawn bowls. Injuries were caused by falls (59%, including trips and slips on the green during play, when traversing the ditch and on steps and paths in areas around the clubhouse or carpark); overexertion (31%, sprains and strains); and being struck by a bowl (7%). Injuries included: sprains and strains (35%); fractures (35%); cuts and bruises (23%). Eight of the 29 cases (28%), all female and aged over 60 years, were admitted to hospital.

The research literature search found no published or unpublished studies on the patterns, causes and prevention of lawn bowls injury. Consequently, this report covers studies that examine injury among older athletes engaged in other sporting activities and includes a detailed discussion of countermeasures to injury implemented in other sports that are transferable (with appropriate modifications) to lawn bowls. Recommendations include: extension of coaching to improve players' technique, pre-participation screening, pre-season conditioning, warm-up and stretching programs, improved footwear design, education of coaches and trainers and the provision of appropriate first aid and rehabilitation. Fall hazards need to be eliminated from the sport, playing environment and club facilities.

It is strongly recommended that lawn bowls clubs collect comprehensive injury data that need to be collated, analysed and reported periodically to assist the development of targeted injury prevention measures.

Key Words:

lawn bowls, injury prevention, overuse, evaluation, countermeasures

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Contents

ACKNOWLEDGMENTS	VII
EXECUTIVE SUMMARY	IX
1. INTRODUCTION	1
1.1 AIM.....	1
1.2 METHOD.....	1
2. PARTICIPATION IN LAWN BOWLS	5
3. AN OVERVIEW OF THE EPIDEMIOLOGY OF LAWN BOWLS INJURIES	7
3.1 VICTORIAN HOSPITAL EMERGENCY DEPARTMENT DATA.....	7
3.2 AUSTRALIAN HOSPITAL EMERGENCY DEPARTMENT DATA	8
3.3 NEW ZEALAND HOSPITAL EMERGENCY DEPARTMENT DATA.....	8
3.4 SPORTS INJURY INSURANCE DATA.....	8
3.5 INFORMATION FROM INFORMAL SOURCES.....	9
3.6 GENERAL RECOMMENDATIONS.....	9
4. BENEFITS OF EXERCISE FOR OLDER PEOPLE	11
5. AN OVERVIEW OF INJURY COUNTERMEASURES FOR LAWN BOWLS	15
5.1 PRIMARY, SECONDARY AND TERTIARY COUNTERMEASURES	15
6. DETAILED REVIEW OF LAWN BOWLS INJURY COUNTERMEASURES	17
6.1 IMPROVED PLAYING TECHNIQUE.....	17
6.1.1 Recommendations for further research, development and implementation.....	17
6.2 PRE-PARTICIPATION SCREENING	18
6.2.1 Recommendations for further research, development and implementation.....	18
6.3 SUITABLE FOOTWEAR.....	18
6.3.1 Recommendations for further research, development and implementation.....	19
6.4 USE OF A BOWLING ARM	19
6.4.1 Recommendations for further implementation.....	20
6.5 ‘NON-SLIP’ MATS	20
6.5.1 Recommendations for further research, development and implementation.....	20
6.6 REMOVAL OF ENVIRONMENTAL HAZARDS.....	21
6.6.1 The green and surrounds	21
6.6.2 Hot weather	22
6.6.3 Recommendations for further research, development and implementation.....	23
6.7 BOWLS AND BAGS.....	23
6.7.1 Recommendations for further research, development and implementation.....	24
6.8 APPROPRIATE PHYSICAL PREPARATION	24
6.8.1 Warm-up and stretching	24
6.8.2 Training	25
6.8.3 Cool down	26
6.8.4 Recommendations for further research, development and implementation.....	26

6.9	EDUCATION OF COACHES AND TRAINERS.....	26
6.9.1	Recommendations for further development and implementation.....	27
6.10	PREVENTING OVERUSE INJURIES	28
6.10.1	Recommendations for further research, development and implementation.....	28
6.11	APPROPRIATE FIRST AID AND REHABILITATION	29
6.11.1	Sports first aid.....	29
6.11.2	Taping and bracing	29
6.11.3	Rehabilitation	31
6.11.4	Recommendations for further research, development and implementation.....	31
7.	CONCLUSION.....	33
8.	REFERENCES	35

Figures

FIGURE 1:	GRADING SCALE FOR ASSESSING THE EXTENT TO WHICH COUNTERMEASURES HAVE BEEN FULLY EVALUATED	2
FIGURE 2:	AGE OF LAWN BOWLERS 1993/94 TO 1995/96.....	5
FIGURE 3:	COUNTERMEASURE OPPORTUNITIES IN THE INJURY CHAIN	15
FIGURE 4:	THE BOWLING GREEN AND SURROUNDS.....	21

Tables

TABLE 1:	THE HEALTH BENEFITS OF EXERCISE FOR OLDER PEOPLE.....	11
TABLE 2:	PREVENTATIVE MEASURES IN SPORTS-RELATED INJURIES AND PROBLEMS AMONG THE ELDERLY	13
TABLE 3:	LAWN BOWLS INJURY COUNTERMEASURES	16

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EXECUTIVE SUMMARY

Lawn bowls is a popular sport and leisure activity in Australia. It is estimated from the 1995/96 Australian Bureau of Statistics (ABS) population household survey that 296,000 Australian men and women play bowls. It is the fifth most popular sport in Australia behind aerobics, golf, tennis and netball. Most participants (92%) are over 45 years old, 61% are male and 39% are female. The sport is played for the challenge and competition, personal enjoyment in terms of being active and spending time outdoors, and social reasons. Also, participation is recommended to older people by health professionals because the sport provides low impact, therapeutic exercise in a social and supportive atmosphere.

There is a notable lack of information on lawn bowls injuries. No data are collected at club or association level. Also, there are no published or unpublished epidemiological studies indicating the frequency and pattern of injury among bowls players. The only information that was available was from hospital emergency department surveillance systems.

Data on lawn bowls injury from Victorian, Australian and New Zealand hospital emergency department databases reveal that presentations are uncommon. The low frequency of cases presenting to E.D. departments is probably explained by the lower physical intensity of bowls compared with other sports. Also, anecdotal evidence and research on sports injuries among other groups of older athletes suggest that lawn bowls injuries are more likely to be intrinsic in nature – sprains, strains and joint problems – which are not well-captured in hospital emergency department data collections. Players with these injuries are more likely to consult general practitioners, other health and sports injury treatment practitioners (for example physiotherapists, chiropractors and masseurs) or self-manage their injury. There are no comprehensive data collections on these types of treatments in Victoria, although a survey of sports medicine clinics is in progress.

There were 29 cases of lawn bowls injury recorded on Victorian hospital emergency department surveillance systems. Fifteen cases (3 males; 12 females) were identified on the new Victorian Emergency Minimum Database (VEMD) over the two-year period (1995-97). These data are drawn from 25 Victorian hospitals. The number of cases extracted from the database probably underestimates the actual number of lawn bowls injury presentations because the specific sport being played at the time of injury is inconsistently reported in VEMD sports injury case records. Another 14 cases (4 males; 10 females) were recorded on the superseded Victorian Injury Surveillance System (VISS) database that collected adult injury data from 4 Victorian hospitals for various periods between 1988 and 1995.

Injuries were caused by falls (59%, including trips and slips on the green during play, when traversing the ditch and on steps and paths in areas around the clubhouse and car park); overexertion (31%, sprains and strains); being struck by a bowl (7%) and foreign body in eye (3%). Injuries included: sprains and strains (35%); fractures (35%); cuts and bruises (23%); and one case of shoulder injury, not specified (3.3%). The most common sites of injury were the ankle and the wrist. Approximately three-quarters (76%) of the injured players were female, indicating they may be at higher risk of injury because ABS sports participation data indicate they comprise only 39% of bowls participants. Eight of the 29 cases (28%), all female and aged over 60 years, were admitted to hospital.

A similar pattern of injury was evident when Australian data on lawn bowls injuries, from the National Injury Surveillance Unit (NISU) in Adelaide, were analysed. The NISU

database recorded 65 lawn bowls injury cases (from 50 participating hospitals across Australia) during the period 1986-1997. Seventy-one per cent of injured bowlers were female; 65% were aged over 60 years. The major causes of injuries were falls, including trips and slips (54%); overexertion resulting in sprains and strains (28%); and being hit by the bowl (18%). The injurious falls were fairly evenly divided between loss of balance, slips (mostly on the green but a few on steps, bank and paths) and trips (mostly over bowls). Fractures (37%) and sprains and strains (31%) were the most common types of injury. Eleven cases (17%) were admitted to hospital.

Anecdotal evidence from the Royal Victorian Bowls Association (RVBA) suggests that the common scenarios for falls in lawn bowls are:

- when crossing the ditch from the bank to the green, players step forward over the ditch, instead of sideways, and stumble or slip into the ditch;
- players deliver the bowl when unbalanced (there needs to be 65-70% weighting on the leading foot to maintain balance, otherwise a bowler falls over); and
- players step backwards during play and fall over the bowls that are behind them.

Older people, especially older women, are particularly vulnerable to fall-related fractures that can cause longer-term disability and may reduce quality of life and independence. Because of the older age of participants in lawn bowls, clubs and associations need to be vigilant about eliminating fall hazards from the game, the playing environment and club facilities (including the car park).

Our literature search found no published or unpublished research studies on the pattern, causes and prevention of injury in lawn bowls. Consequently, this review covers studies that examine sports-related injury in active older people (mostly athletes) and provides a detailed discussion of measures to prevent injury in other sports that are transferable (with appropriate modifications) to lawn bowls.

Generally, the research evidence on the effectiveness of many of the countermeasures to sports injury is inconclusive. Sports injury research on recreational players is a relatively new discipline and large controlled studies that can provide definitive answers are rare. More large-scale epidemiological studies are needed to identify the pattern of sports injury in the general population of lawn bowls players and the role of various risk factors in causation. Clubs and associations can contribute to this endeavour by systematically collecting injury data. Basic scientific studies are also required to better understand the mechanisms of injury. Lastly, controlled evaluations 'in the field' are needed to trial whether the various countermeasures to injury are effective. The recommendations for research and countermeasure implementation in this report are based on a critical analysis of available research evidence as well as discussions with the experts acknowledged in this report.

GENERAL RECOMMENDATIONS

- Lawn bowls clubs and associations should collect data on lawn bowls injuries that occur in practice, social and competition games and in and around the club facilities, along with information on the circumstances of the injuries. These data need to be collated, analysed and reported periodically by a central agency.

- Data collections should conform to the guidelines for sports injury surveillance being developed and promoted nationally.
- Information about preventing lawn bowls injuries should be disseminated widely through lawn bowls broadcasts, lawn bowls equipment points of sale, lawn bowls magazines and more general magazines, and media outlets.
- Risk management plans for sporting bodies, clubs and associations should be developed, implemented and regularly reviewed.
- Guidelines for minimum safety requirements for lawn bowls events (including the need for emergency telephone contact list, first aid kit etc.) should be developed and widely disseminated.
- Future research to determine injury risk factors or to evaluate the effectiveness of countermeasures need to be controlled studies.

SPECIFIC RECOMMENDATIONS FOR COUNTERMEASURE IMPLEMENTATION, RESEARCH AND DEVELOPMENT

Playing technique

- Investigate the role of incorrect technique in the occurrence of overuse and fall-related injuries in bowls.
- Promote coach training and ensure there is at least one trained coach at every club to advise, monitor and improve the bowling technique of players at all skill levels.

Pre-participation screening

- Conduct more research into the physical well-being and anthropometric measures on which to base pre-participation screening for lawn bowls players.
- Develop a pre-participation screening program specifically for lawn bowls players.
- Promote pre-participation screening and pre-season medical assessment to bowlers.

Footwear

- Advise bowlers to seek professional advice when choosing bowling shoes.
- Encourage players to change their footwear to shoes with grip on the undersole when they finish bowling.
- Develop material for the soles of lawn bowls shoes that is slip resistant yet does minimal damage to the greens.
- Investigate barriers to the use of bowling shoes with grip soles and revise rules accordingly.

- Investigate the involvement of wet greens, especially synthetic greens, in slips and falls.
- Re-design bowling mats so that they have significant grip on the top surface to provide some traction between the shoe and the mat.
- Research questions that need to be answered include:
 - Which features of footwear are protective against injuries?
 - Where should the balance lie between foot protection, the stabilising effects of footwear and flexibility of shoes?
 - What is the interaction between footwear, specific playing surfaces and injury?

Bowling arms

- Widely promote the use of bowling arms to players with physical restrictions as a means of preventing repetitive strain injuries.
- Continue to promote participation in lawn bowls to wheelchair-bound people and those who have disabling back and hand conditions.

'Non-slip' mats

- Incorporate a ridged upper surface in the design of 'non-slip' mats and test to see if the ridging protects players from slipping. If the surface provides improved protection then ridged mats should be adopted.

Environmental conditions

- Develop, implement and monitor risk management plans for bowling facilities to control environmental hazards.
- Reduce the risk of injurious falls in lawn bowls through a multi-faceted approach which could include:
 - the provision of slip resistant steps or a ramp over the ditch onto the green;
 - the installation of hand rails around the footpaths;
 - regular inspection and repair of footpaths;
 - application of anti-slip treatments to walking surfaces;
 - the promotion of changes to bowls footwear to improve its slip resistance;
 - the provision of good lighting at night games;
 - the installation of ramps around the club house; and
 - the provision of plenty of seating.
- Introduce a consistent rule that restricts play in extreme weather conditions.

- Educate players to sip water throughout the game, especially in hot weather, to ensure adequate hydration.
- Promote the use by players of a broad spectrum sunscreen even on cloudy days.
- Advise players to keep undergarments to a minimum in hot conditions.
- Undertake studies to determine the influence of environmental conditions, such as playing surface and weather conditions, on injury.
- Conduct research on the interaction between footwear, specific playing surfaces and injury.

Bowls and bags

- Players should seek professional advice when purchasing bowls.
- As players get older they should review the weight and size of their bowls.
- Players who have difficulty lifting their bowls bag should use a trolley.

Physical preparation

- Develop and promote guidelines on current best practice regarding warm-up, cool-down and stretching techniques. These exercise routines should be promoted to all competition and social players through the RVBA, clubs and the Arthritis Foundation.
- Conduct simple fitness testing prior to each lawn bowls season to ensure players are fit for competition.
- Introduce training sessions to improve fitness and for skills development.
- Educate players about the nutritional and hydration demands of playing lawn bowls, particularly in hotter climates and warmer weather.
- Skills and fitness should be built-up gradually when a player is learning the sport.
- Investigate, through controlled research studies, the role of training and warm-up/cool down in injury prevention and the relative benefits of different types of warming-up, cooling-down and stretching practices.

Education and coaching

- Each club committee should appoint at least one well-respected and advanced bowls player to act as club coach.
- All coaches should be accredited and undergo regular training and re-accreditation.
- Coach education schemes should be updated regularly to ensure they provide current information.

- The coaching manual should be reviewed to include more information on sports injury prevention, treatment and rehabilitation.
- Prevention of injury should be a key responsibility of coaches and the subject should be included in the coaching manual.
- Educational resources for social lawn bowls players need to be developed and disseminated.
- Instruction clinics for the social bowler should be developed and advertised widely.

Preventing overuse injuries

- Investigate the role of conditioning (to improve strength and flexibility) in the prevention of overuse injuries.
- Educate lawn bowlers about the risks and potentially severe consequences of overuse injuries.
- All lawn bowls players should practise appropriate warm-up and stretching routines prior to games and cool downs after games.
- Undertake research into the frequency, patterns and causes of overuse injuries among lawn bowlers.

First aid and rehabilitation

- At least one qualified first aider should be on duty at all bowls events.
- All bowling clubs should have a well-stocked first aid kit, telephone and emergency contact numbers on display.
- Return to play after injury should only occur after full recovery.
- More controlled research is needed to determine the effectiveness of taping and bracing of body joints, for example the ankle, as a primary prevention injury countermeasure.

1. INTRODUCTION

Lawn bowls is believed to have originated 4,000 years ago in Egypt where a rolling ball game was played at the Royal Courts (Brasch, 1986). This game spread from Egypt, through Greece and Rome to England, where the modern game was born. It was not until the 16th century that bowls were biased (a weight was placed inside one side of a bowl causing it to roll in a curve). Many of the modern rules were devised in the 18th century under W.W. Mitchell (Brasch, 1986). Currently, the game is played in 40 countries, twice the number of countries that participated two decades ago.

Lawn bowls is a popular sport and leisure activity in Australia. Participants may play the sport for the challenge and competition, personal enjoyment in terms of being active and spending time outdoors and social reasons. Also, health professionals may recommend participation in lawn bowls to older people because the sport provides low impact, therapeutic exercise in a social and supportive atmosphere.

There is a notable lack of data from Victoria or elsewhere on the frequency and pattern of injury in lawn bowls. Also, our literature search found no published or unpublished research studies on the causes and prevention of injury in lawn bowls. A brief review of the limited data on lawn bowls injury from hospital emergency department databases is given to set the scene for the subsequent discussion of a range of potential countermeasures. The recommendations for research and countermeasure implementation in this report are based on a critical analysis of available research evidence as well as discussions with the experts acknowledged in this report.

1.1 AIM

The aim of this report was to critically review the formal (published) and informal literature that describe and/or evaluate strategies and measures to prevent lawn bowls injuries. Because our literature search revealed there were no specific research studies on lawn bowls injury and potential countermeasures, this review is focussed on studies that examine injury among older athletes and provides a detailed discussion of injury prevention measures from other sports that appear to be transferable to lawn bowls.

1.2 METHOD

The sources of information used to compile this report were:

- *Medline* CD-ROM for published medical literature (over the past 13 years)
- *Sport discus* CD-ROM search for published sports literature (over the past 13 years)
- injury prevention conference proceedings
- discussions with lawn bowls organisations
- Internet and World Wide Web sites.

The literature gathered for this review (which is mainly focussed on studies of injury among older athletes and preventive measures recommended from research in other sports) was critically assessed to determine the extent to which the various countermeasures had been

fully evaluated and demonstrated to be effective in preventing injuries. A gradation scale for the strength of the evidence presented in the identified literature was developed. This is shown in Figure 1.

Figure 1: Grading scale for assessing the extent to which countermeasures have been fully evaluated

STRENGTH OF THE SCIENTIFIC EVIDENCE	TYPE OF SCIENTIFIC EVIDENCE
Least	Anecdotal or informed/expert opinion
↑	
	Laboratory-based/equipment testing
	Data-based evidence (uncontrolled)
↓	
Most	Controlled evaluations

This scale reflects an epidemiological and rigorous scientific approach to injury prevention that considers demonstration of the effectiveness of a countermeasure’s performance in the field to be the highest level of ‘proof’. This is particularly important for sports injury countermeasures where any change to the nature of the game is an important factor to be considered. In general, changes to factors such as how the sport is played or undertaken, and the behaviour of the participants can only be measured during “in-the-field” evaluations.

At the lowest level of proof (i.e., the “least” evidence end of the scale) are anecdotal reports of injuries and their prevention and comments based on informed or expert opinion. This category would include, for example, statements like “I treated 5 cases of back injuries last year and all would have been prevented if prayers had used an adequate technique.” Of course, some expert/informed opinion carries more weight than others, particularly when it is based on a critical review of available information.

Laboratory-based evidence is a very important source of information about sports injury countermeasures. This category includes reports that have explored equipment design and testing, development of standard testing procedures and biomechanical research, including that performed on animals, cadavers and simulated body tissue such as crash-test dummies. Such information provides detail about the extent to which countermeasures such as padding perform under certain stress and/or impact conditions. This research is generally performed under laboratory conditions that are often controlled. However, such conditions may not be a good representation of actual field or playing conditions.

Data-based evidence can take a number of forms. Routine injury surveillance systems document the incidence of new injury cases over periods of time. Patterns in data can be examined over time to draw conclusions about the impact that countermeasures may have on injury rates. Cross-sectional epidemiological studies, for example surveys, provide some

information about injury prevalence at a given point of time but are unable to assess the influence of countermeasures on injury rates. Quasi-experimental studies enable a comparison of pre-intervention with post-intervention data to examine the effects of countermeasures. These may include comparison groups.

Controlled evaluations provide the most definitive evidence on the impact of countermeasures. Case-control studies and longitudinal (cohort) studies are common forms of controlled studies. Neither study type allows random assignment of people (or injuries) to test and control groups, though they are examples of natural experiments. A randomised controlled trial is considered to provide the best evidence. In such studies, the units of interest are randomly assigned to test and control groups.

Another important aspect of countermeasure implementation is the extent to which they are accepted or adopted by the users for whom they were intended. Countermeasures should be acceptable to those they were designed to protect. Community consultation and awareness programs must therefore be considered in any implementation process. It is also important to assess barriers against the use of injury countermeasures. Investigation of players' and officials' attitudes, knowledge and behaviours is crucial to the successful implementation of countermeasures to injury. Studies of these factors should be conducted both prior and during implementation of countermeasures because findings highlight the need for behavioural or educational changes at either the individual or organisational level. Because of the importance of this sort of research, relevant studies of this type were included in this review.

Another measure of the success of countermeasures is a demonstration of their cost/benefit ratios. This information is often needed by regulatory bodies and by those involved in policy and sports rulemaking, to inform their decisions about measures to reduce sports injury. To date, there have been no benefits-costs studies on sports injury countermeasures.

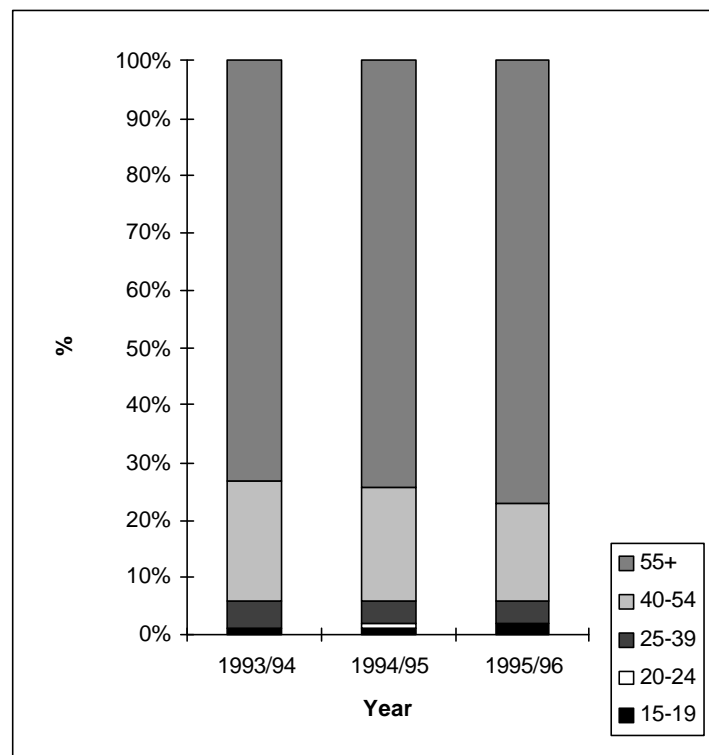
Generally, the research evidence on the effectiveness of many of the countermeasures to sports injury is inconclusive. Sports injury research at the level of recreational players is a relatively new discipline and large controlled studies that provide definitive answers on sports injury risk factors and the effectiveness of preventive measures are rare. More large-scale epidemiological studies are needed to identify the pattern of sports injury in the general population of players and the role of various risk factors in causation. Clubs and associations can contribute to this endeavour by systematically collecting injury data for their sport. Basic scientific studies are also required to better understand the mechanisms of injury. Lastly, controlled evaluations 'in the field' are required to trial whether the various countermeasures to injury are effective.

2. PARTICIPATION IN LAWN BOWLS

A large population household survey conducted by the Australian Bureau of Statistics (ABS) in 1995/96, indicated that 296,400 Australians over the age of 15 years participated in lawn bowls (ABS Population Survey Monitor Data, 1997). Lawn bowls was the fifth-highest ranked sport and recreation activity in Australia (in terms of participation) behind aerobics, golf, tennis and netball. The survey indicated that the vast majority of lawn bowls participants (92%) are over 45 years old and that 61% of participants are male and 39% are female. Over one-half of participants (55%) reported that they played lawn bowls more than once a week. It was estimated from this Australian survey that 75,400 Victorians participate in lawn bowls (57% male and 43% female). These data are consistent with the Royal Victorian Bowls Association's estimations that 45,000 Victorian men and 29,000 women currently participate in lawn bowls on a regular basis (RVBA, personal communication).

The proportion of older bowlers playing the sport appears to have grown since 1993/94 (figure 2). In the 1993/94 ABS survey it was reported that 73% of lawn bowlers were over the age of 55 years. In 1995/96, 77% of players fell within this age group (ABS Population Survey Monitor Data, 1997).

Figure 2: Age of lawn bowlers 1993/94 to 1995/96



Source: ABS Population Survey Monitor Data, 1997.

3. AN OVERVIEW OF THE EPIDEMIOLOGY OF LAWN BOWLS INJURIES

There are no comprehensive epidemiological studies indicating the frequency and patterns of injury among lawn bowls players and no injury data are collected at club or association level. The only information that was available on lawn bowls injury was from the Victorian and Australian hospital emergency department databases and some New Zealand hospital and sports insurance data. The hospital data probably only represent a small proportion of the injuries that occur in lawn bowls as it is likely that most injured players would seek treatment elsewhere (for example, from general practitioners, physiotherapists, chiropractors and masseurs) or self-treat their injuries.

3.1 VICTORIAN HOSPITAL EMERGENCY DEPARTMENT DATA

There were 15 lawn bowls injury hospital presentations (3 males, 12 females) recorded on the new Victorian Emergency Minimum Database (VEMD) over the two-year period 1995-1997. The database covers 25 Victorian hospitals. The number of cases extracted from the database probably underestimates the actual number of lawn bowls injury presentations because the specific sport being played at the time of injury is not consistently reported in VEMD sports injury case records.

Nine of the fifteen injury cases (60%) were due to falls (including slips). The circumstances of the fall injuries were described (in the one-line case narratives) as follows: *stumbled/slipped/fell playing bowls (3 cases); went to step up the ditch, slipped; stepped up a step, overbalanced; fell onto left elbow; slipped on mud in bowls club carpark; fell at bowling club*. The other six cases were overexertions and injuries associated with the bowling ball: *injured knee while bowling (2 cases); painful hip and thigh from playing bowls; went over on ankle; hit on face by bowling ball; dropped bowling ball on finger*. Injuries included: sprains and strains (6 cases); cuts and bruises (5 cases); fractures (3 cases) and shoulder injury (1 case). Three cases (20%, all female) were admitted to hospital.

There were 14 cases of lawn bowls injury (4 males; 10 females) recorded on the superseded Victorian Injury Surveillance System (VISS) database that held adult injury data from four Victorian hospitals for different periods from 1988 to 1995. The pattern of injury was similar to that reported from the new VEMD surveillance system.

Eight of the fourteen injury cases (57%) were due to falls (including trips and slips). The circumstances of the injurious falls (derived from case narratives) were: *slipped on wet grass/bowling green/while playing (3); slipped on bowling green steps/walking along path (2); fell when stepping onto green (1); fell while bowling (1); and tripped over male (1)*. The other injuries were caused by overexertion (5 cases) and there was one case of a foreign body in the eye. Injuries included: fractures (7); sprains and strains (4) and cuts and bruises (3). Five cases (35.7%, all females and aged over 60 years) were admitted to hospital.

Adding these case series together, the 29 lawn bowls injury cases recorded on the VEMD and VISS databases were caused by falls (59%, including trips and slips on the green during play, when traversing the ditch and on steps and paths in areas around the clubhouse and car park); overexertion (31%, sprains and strains); being struck by a bowl (7%) and foreign body in the eye (3%). Injuries included: sprains and strains (35%); fractures (35%); cuts and

bruises (23%); and one case of shoulder injury, not specified (3.3%). The most frequently injured sites of the body were the ankle and the wrist. Approximately three-quarters (76%) of the 29 injured players were female, indicating women may be at higher risk of injury because participation data show they comprise only 39% of bowls players (ABS Population Survey Monitor, 1977). Eight of the 29 cases (28%), all female and aged over 60 years, were admitted to hospital.

3.2 AUSTRALIAN HOSPITAL EMERGENCY DEPARTMENT DATA

Supplementary information on lawn bowls injury was also sought from the Australian National Injury Surveillance Unit (NISU). Emergency department data were provided to NISU by approximately 50 participating hospitals throughout Australia (including VISS hospitals) during the period 1986-1997. The NISU database recorded 65 lawn bowls injury cases. Seventy-one per cent of injured bowlers were female; 65% were aged over 60 years. The major causes of injuries were: falls, including trips and slips (54%); overexertion resulting in sprains and strains (28%); and being hit by a bowling ball (18%). The injurious falls were fairly evenly divided between loss of balance, slips (mostly on the green but a few on steps, bank and paths) and trips (mostly over a ball).

Seventy-five separate injuries were sustained by the 65 injured players. Injuries were fairly evenly spread between the upper extremities (41% of all injuries) and lower extremities (47%). Ankle and wrist injuries were the most common injuries, each accounting for 15% of cases. Fractures (37%) and sprains and strains (31%) were the most common types of injury. Eleven of the 65 injured players (16.9%) were admitted to hospital.

3.3 NEW ZEALAND HOSPITAL EMERGENCY DEPARTMENT DATA

Hospital emergency department presentations data were obtained from New Zealand to see whether there were any major difference in the frequency and pattern of reported lawn bowls injury presentations in New Zealand compared to Victoria (and Australia). The Injury Prevention Research Unit, University of Otago, reported that 259 cases of bowling-related injury were recorded on their emergency department database over the period 1979 to 1995 (approximately 15 injury cases per year). Although lawn bowls injury cases could not be extracted separately from ten-pin bowling cases, the place of occurrence of injury was most frequently identified as a bowling green (Chalmers, personal communication).

The New Zealand data confirm that hospital emergency department presentations for bowls injuries are uncommon. Unfortunately, lawn bowls cases could not be separated from 10-pin bowling cases for analysis. Sixty-three per cent of all injured bowlers (lawn and 10-pin) were male and 27% female. This is the reverse of the pattern for lawn bowls injury cases presenting to Victorian and Australian hospital emergency departments and may reflect the inclusion of 10-pin bowls injury cases in the dataset. Injuries were most frequently caused by falls (80%) and overexertion (12%). The major types of injuries were fractures (61%), sprains (11%), superficial wounds (11%) and dislocations (4%).

3.4 SPORTS INJURY INSURANCE DATA

Sports insurance data give a better indication of the annual frequency of medically treated sports injury because treatments by a broader range of health professionals are included. Nonetheless, these data also underestimate injury frequency because not all cases meet the eligibility requirements for an insurance claim and some injured players do not submit

claims even if eligible. The Accident Rehabilitation Compensation Insurance Corporation (ACC) provides universal insurance coverage for all sports participants in New Zealand. There is no similar scheme in Victoria and no private insurance company specialises in offering coverage to lawn bowlers through Victorian clubs or Lawn Bowls Associations.

In the 12 months period from 1 July 1995 to 30 June 1996, 100 new claims were made to the ACC by injured bowlers (mostly lawn bowlers). The cost of these claims was \$114,000, excluding medical treatment costs where the health care provider rather than the claimant is normally reimbursed directly and public hospital and ambulance costs, which are bulk-funded. In addition, there were 92 claims for ongoing expenses from previous years which cost \$466,000 (ACC, 1996). These data indicate that hospital emergency department surveillance systems probably underestimate the incidence of lawn bowls injury.

3.5 INFORMATION FROM INFORMAL SOURCES

The Royal Victorian Bowls Association (RVBA) does not keep statistical records on bowling injuries. Unlike other sports, there is no regulation that requires club members to join a sports insurance scheme. It is left to the individual club to decide whether player insurance is required. Most clubs have public liability insurance, but do not require participants to take out personal sports insurance or promote it to members (RVBA, personal communication).

Anecdotal evidence from the RVBA (personal communication, P. Wiltshire, Executive Officer & R Middleton, Development & Promotion Officer) suggests that the common scenarios for falls in lawn bowls are:

- when crossing the ditch from the bank to the green, players step forward over the ditch, instead of sideways, and stumble or slip into the ditch;
- players deliver the bowl when unbalanced (there needs to be 65-70% weighting on the leading foot to maintain balance); and
- players step backwards during play and fall over the bowls that are behind them.

The key informants attribute these falls (that may result in sprains, strains and fractures) to lack of care or concentration. The lack of comprehensive information on lawn bowls injury is a barrier to prevention. Lawn bowls clubs should systematically collect injury data. These data should be collated and analysed at the association level or by another agency to provide information on patterns of injury including risk and contributory factors that can then guide the development and implementation of prevention measures.

3.6 GENERAL RECOMMENDATIONS

- Lawn bowls clubs and associations should collect data on lawn bowls injuries that occur in practice, social and competition games and in and around the club facilities, along with information on the circumstances of the injuries. These data need to be collated, analysed and reported periodically by a central agency.
- Data collections should conform to the guidelines for sports injury surveillance being developed and promoted nationally.

- Information about preventing lawn bowls injuries should be disseminated widely through lawn bowls broadcasts, lawn bowls equipment points of sale, lawn bowls magazines and more general magazines, and media outlets.
- Risk management plans for sporting bodies, clubs and associations should be developed, implemented and regularly reviewed.
- Guidelines for minimum safety requirements for lawn bowls events (including the need for emergency telephone contact list, first aid kit etc.) should be developed and widely disseminated.
- Future research studies to determine injury risk factors or to evaluate the effectiveness of countermeasures need to be controlled evaluations.

4. BENEFITS OF EXERCISE FOR OLDER PEOPLE

Although participation data show that lawn bowls has increased its appeal to younger age groups, the large majority of current participants (77%) are over the age of 55 years (ABS Population Survey Monitor Data, 1997).

Both ageing and illness cause progressive losses of physical and functional capacity, which render older people more vulnerable to overloading of the musculoskeletal and cardiovascular systems (Kallinen and Markku, 1995). However, it is now thought that a significant proportion of the physical decline that was formerly attributed to the ‘natural’ process of ageing, may in fact be caused by the age-related decline in physical activity and loss of fitness over time (Australian Sports Medicine Federation, undated; Kallinen and Markku, 1995).

The progressive loss of physical function observed in older people is outlined in Table 1, with information on the benefits of exercise in ameliorating this process.

Table 1: The health benefits of exercise for older people

‘NATURAL’ PROCESS OF AGEING	BENEFITS OF EXERCISE
Decreased muscle mass, strength, endurance and co-ordination.	Strength training at any age produces improvements in strength and ability to carry out normal daily and sporting activities.
Decreased tendon and joint flexibility, mobility and stability.	Flexibility and mobility exercises are beneficial in reducing the effects of the natural ageing process. These activities are key elements in the treatment of arthritis.
Progressive loss of bone and muscle mass and strength which increases the risk of fractures.	General exercise, weight bearing and balance exercise have been shown to decrease the risk of falls among older people which may prevent fractures.
The heart becomes less efficient and less powerful. Blood vessels lose elasticity and arteries become more rigid. Blood pressure and atherosclerosis may increase. Aerobic and anaerobic capacity is reduced.	Sports of a suitable intensity, frequency and duration can reduce the decrements in cardiovascular function. The heart becomes more efficient as the muscles are strengthened, thereby increasing aerobic and anaerobic capacity. There is some evidence to show that active older adults have lower blood pressure than their less active counterparts and that a regular aerobic exercise program can reduce high blood pressure among older individuals.
The tissues of the lungs lose elasticity, the chest wall becomes rigid and the ventilatory muscles lose strength thereby decreasing quick exhalation.	While exercise hasn’t been shown to assist in better respiratory function, it has been shown to benefit sufferers of chronic respiratory diseases (eg. Emphysema).

Sources: Australian Sports Medicine Federation (undated); Adams (1991); Åstrand (1992), Hardman (1992); Kallinen and Markku (1995); King & Tinetti (1996); and Pescatello & DiPietro (1993).

There is some research evidence that shows that older people who have maintained high levels of physical activity throughout their lives suffer only a small loss of aerobic capacity

over time and have a functional capacity that is comparable to younger sedentary people (Kallinen and Markku, 1995). The beneficial effects of physical exercise cannot be stored for decades and, therefore, regular exercise regimes must be maintained over the lifespan of an individual for the accrual of optimal health benefits.

Lawn bowls provides lower intensity exercise compared with other sports played by older people (e.g., golf and tennis). Therefore, it is reasonable to believe that the risk of exercise-related cardiovascular and other medical complications, and sports injuries should be lower among lawn bowls players. In the only published study on the fitness level of lawn bowlers, Lowdon and Pateman (1980) examined the health effects of different activity patterns among older people by comparing very active, elderly competitive athletes with lawn bowlers in the same age group (65-82 years). Data were collected on a number of cardiovascular health and fitness parameters. The competitive athletes performed significantly better than the lawn bowling group on the tests of body fat content, resting heart rate, submaximal work rate, perceived exertion and VO_2 (oxygen uptake at rest and after exercise which measures the relationship between work rate and heart rate).

The lawn bowlers' mean body fat level (13%) was then compared to the published levels for other older groups. The authors reported that it was much lower than the body fat level in U.S. sedentary septagenarians (30%) and lower than that for U.S. elderly men in short term training programs (16-21%). The researchers concluded from these comparisons that regular physical activity such as bowling helps to maintain a lower level of body fat in participants. However, the test results for cardiovascular fitness among the lawn bowling group were similar to published results for sedentary men of a similar age. On the basis of this evidence, Lowdon and Pateman (1980) concluded that playing lawn bowls regularly does not adequately develop cardiovascular (aerobic) fitness.

This study is dated and the conclusions of the authors were based on low numbers (8 athletes and 5 bowlers). However, lawn bowlers would be well advised to supplement their bowls playing with some form of regular moderate aerobic exercise, such as tailored aerobic exercise sessions or brisk walking, to gain the full health benefits of a regular exercise regime (Pescatello & DiPietro, 1993). Bowls clubs could provide or promote local aerobic exercise sessions, swimming and brisk walking to their members to raise their aerobic fitness levels.

Based on their review of the research literature and their own research on older athletes, Kallinen and Markku (1995) report that the beneficial effects of exercise appear to occur with a lower dose in the elderly compared to their younger counterparts. They warn, however, that the harmful effects may also occur at a lower dose and advise that, in general, older people should avoid high impact loading and increase loading gradually when taking up or increasing the intensity of exercise. The authors also recommend that exercise intensity should be decreased, and the training frequency or duration increased, for older people who are frail and/or have physical or medical complications.

Kallinen and Markku (1995) conclude, from their review of thirteen descriptive epidemiological studies of sports-related injuries in active elderly people (mostly athletes), that there is evidence to suggest that:

- falls and/or slip injuries and strains are the most common acute injuries among elderly athletes;

- the most common tissue injured is the muscle, the most typical injury was muscle strain (especially in strength and power sports);
- acute Achilles tendon injuries appear to increase with age;
- the rate of chronic overuse injuries is not associated with age which suggests that the amount of training, rather than chronological age, is a more important predisposing factor to injury;
- overuse injuries are more diffuse in nature among older athletes - a substantial proportion cannot be located in any specific tissue;
- the wrist, back, muscle and elbow of the dominant arm are the most common locations of chronic ailments among golfers and chronic shoulder problems are more common among the older group of golfers than their younger counterparts [a higher risk of chronic overuse elbow and shoulder injuries to the dominant arm has also been noted among middle-aged to older tennis players (Kamien, 1990)]; and
- chronic overuse injuries among older athletes may cause some disability over an elongated period (around 2 years).

Kallinen and Alen (1985) devised a table of intrinsic and extrinsic preventive measures to reduce the risk of sports injuries among older people. The recommended preventive measures were based on findings from their research on 97 elderly Finnish athletes (age range 70-81 years) who were still active in training and competition in strength/power and endurance sports (Table 2).

Table 2: Preventative measures in sports-related injuries and problems among the elderly

Intrinsic measures
Careful warming-up to prevent acute muscular strain
Careful cooling-down to prevent cardiovascular complications
Adequate cardio-respiratory fitness and muscular strength in respect to the demands of the particular sport
Adequate neurophysiological capacities in respect to the physical demands of the particular sport
Multiphasic training, also including training of muscular strength and neurophysiological capabilities (balance, co-ordination, reaction time)
Stretching to maintain the elasticity of the tissues
Extrinsic measures
Taking environmental conditions into account (light conditions, cold/hot)
Avoiding abrupt changes in the amount of training
Adequate and quick treatment of injuries, regular medical check ups
Proper equipment (eg. footwear) and sport terrains (avoiding high impact loading)

Source: Kallinen & Alen (1985)

One of the most common causes of both morbidity and mortality in the elderly population is injury from falls (Oxley et al. 1994; Kallinen and Markku 1995). Australian Bureau of Statistic data for 1986-1992 indicate that 45% of all injury deaths to those aged over 65 years were caused by falls (ABS, 1993). In a review article on falls among the elderly, King and Tinetti (1996) estimate from a number of studies that, in a given year, approximately 5-

15% of falls among older people cause serious injury, three-quarters of which are fractures. Hip fractures are reported to occur in 1-2% of falls and have the gravest consequences for older people in terms of mortality, morbidity and subsequent loss of independence.

The limited data on lawn bowls injury show that the greens, surrounds and club facilities present some falls risk to players. Lawns bowls clubs need to be especially vigilant to identify and remove fall hazards because of the older age of participants in the sport and the potentially serious repercussions of fall-related injuries (especially hip fractures) in older people. The approach that should be taken by clubs to remove environmental hazards is outlined in section 6.6.1.

The exact role of regular physical activity in the prevention of falls is not clearly understood (Era et al., 1991; Kallinen and Markku, 1995). It has been shown in a number of randomised controlled trials that tailored exercise programs and Tai Chi, if practised regularly, can prevent falls among older people (King & Tinetti, 1996; Kallinen and Markku, 1995, Wolf et al., 1996, Campbell, 1997). Balance training and exercises which strengthen the lower extremities, back and neck are important components of exercise programs aimed at preventing falls in the elderly (Tinetti and Speechley, 1989; Kallinen and Markku, 1995). Whether lawn bowls provides the kind of balance and strength exercise that reduces the risk of falls among older people has not been researched but would be an interesting study considering that the sport is able to be played by adults well into their later years.

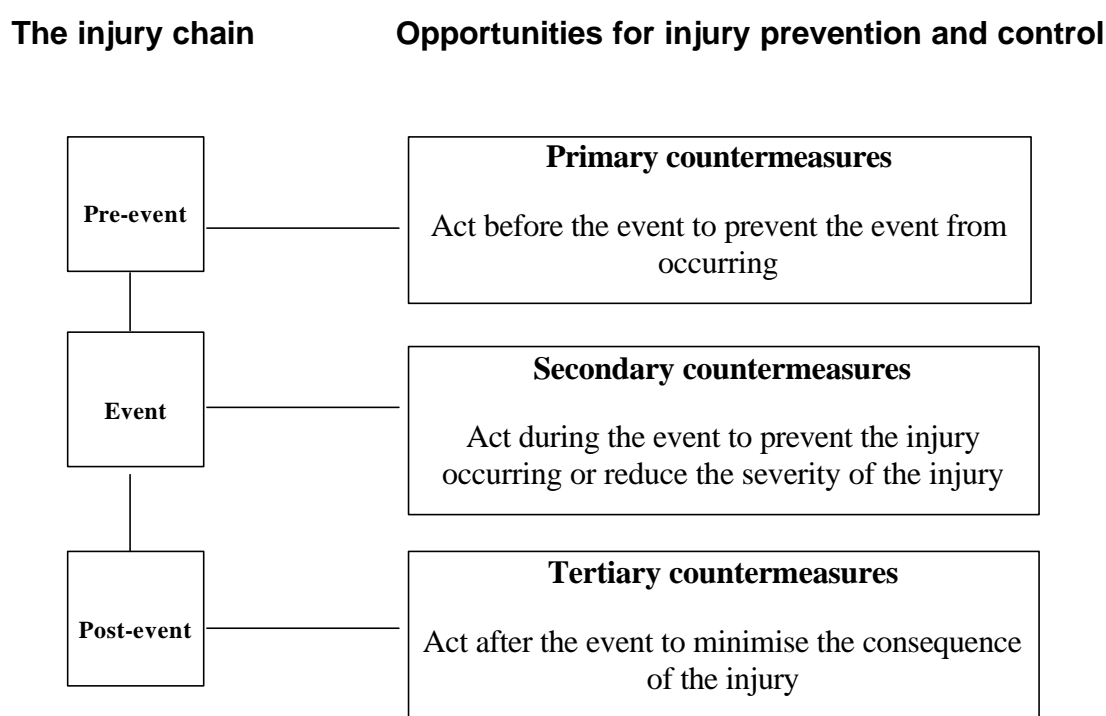
5. AN OVERVIEW OF INJURY COUNTERMEASURES FOR LAWN BOWLS

Injuries may be viewed as the culmination of a set of circumstances and pre-existing conditions that may best be understood as a chain of events (figure: 3): pre-event, event and post event (Robertson, 1983). Injury countermeasures are measures that can “counter”, that is prevent or reduce, the risk of injury. They should be targeted at the links in this chain, equating to primary (pre-event), secondary (event) and tertiary (post-event) prevention (table 3).

5.1 PRIMARY, SECONDARY AND TERTIARY COUNTERMEASURES

A number of researchers have described how countermeasures should be targeted at the different links in the chain of events leading to injury (Haddon, 1972; Ozanne-Smith & Vulcan, 1990; Watt & Finch, 1996). Primary countermeasures, such as pre-participation fitness programs, act before an event or incident that could potentially lead to injury. Secondary countermeasures, such as protective equipment use, act during the event to prevent the injury occurring or to reduce the severity of the injury. Tertiary countermeasures, such as prompt and appropriate first aid, act in the immediate aftermath of an injury event and minimise the consequences of injury (figure 3).

Figure 3: Countermeasure opportunities in the injury chain



Source: Ozanne-Smith & Vulcan (1990)

There are a number of factors that may contribute to the risk of injury among sports participants. Generally, more than one factor is involved in each injury. Consequently, a

range of countermeasures at the primary, secondary and tertiary levels should be considered when designing injury prevention programs (Table 3).

Table 3: Lawn bowls injury countermeasures

Primary	Secondary	Tertiary
<ul style="list-style-type: none"> • Pre participation screening and good management of medical conditions • Pre-season conditioning • Fitness training • Coach education and provision of coaching at all clubs • UV protection • Good nutrition • Prophylactic taping and bracing • Use of orthotics if need indicated • Provision of safe playing environment e.g., non-slip mats, surface, and ramp over ditch at access point/s to green • Provision of hand rails on stairs and steps, non-slip pedestrian surfaces in and around clubhouse 	<ul style="list-style-type: none"> • Safe playing environment • Use of bowling arm if appropriate • Attention to technique • Non-slip surface • Non-slip footwear • Hip protectors for women at high risk of fractures • Adequate water intake during game 	<ul style="list-style-type: none"> • Ready access to first aid equipment • Prompt first aid by trained first aider • Appropriate treatment - rest, ice, compression, elevation, referral (RICER) • Full rehabilitation and return to play only when fit • Taping and bracing to prevent re-injury

In the next section, the literature assessing the effectiveness of the various countermeasures for injury listed in Table 3 is reviewed. For each countermeasure, the rationale for its use as a safety measure is presented, together with a critical review of the extent to which it has been fully evaluated.

6. DETAILED REVIEW OF LAWN BOWLS INJURY COUNTERMEASURES

This section provides a detailed review of information relevant to potential lawn bowls injury countermeasures. In addition, suggestions are made for countermeasure implementation along with recommendation on research and development.

6.1 IMPROVED PLAYING TECHNIQUE

As for most sports, faulty playing technique is probably a major cause of lawn bowls injuries. The technique used by players has the potential to prevent or, conversely, cause injury. Incorrect technique includes incorrect grip of the bowl, incorrect delivery and poor balance. Reduction in the ability to maintain balance is common among older people. As has been mentioned, specific balance and strength training programs can reduce the risk of falls among older people (King & Tinetti 1996).

Williams and Pynt (undated) outlined the most important points in the delivery of the bowl:

1. Place weight towards balls of the feet, with knees relaxed.
2. Focus eyes along the aiming line.
3. Forearm of bowling arm should run down towards the wrist.
4. Keep shoulders square to the line of delivery.
5. Allow the weight of the bowl to determine the backswing.
6. Take a normal walking step (knee of back leg close to rear of front leg).
7. Step as the bowling arm straightens at the bottom of the backswing for correct timing and co-ordination.
8. Keep a firm straight arm as the jack or bowl is released.
9. The bowling arm should finish no higher than the forward knee.
10. Step forward off the mat after the jack or bowl has been delivered and has travelled at least 4 metres.

Valuable advice on correct bowling technique can be found in three sources: *In the Groove* (Royal Victorian Bowls Association, 1995); *The National Lawn Bowls Manual for Coaches* (Williams & Pynt, undated); and *Bending for Bowlers* (DeCastella, 1991).

It is important to have a trained, experienced and respected coach available at each club to aid the development of correct technique and the detection of faults, especially in learners and novices.

6.1.1 Recommendations for further research, development and implementation

- Investigate the role of incorrect technique in the occurrence of overuse and fall-related injuries in bowls.

- Promote coach training and ensure there is at least one trained coach at every club to advise, monitor and improve the bowling technique of players at all skill levels.

6.2 PRE-PARTICIPATION SCREENING

Physical health and anthropometric factors (e.g., body somatype, static balance, anaerobic fitness) may be associated with an increased risk of injury. Pre-participation screening aims to identify people with conditions that may predispose them to serious injury or death. Screening is designed as a primary injury prevention method, although secondary and tertiary aspects are also included (van Mechelen, 1987). The overall goal of pre-participation screening is to locate diminished motion, strength and flexibility or increased instability (Hershman, 1984; Backx, 1991).

Guidelines for safe participation in veteran sports (Australian Sports Medicine Federation, undated) recommend *medical examination* for: all males over 35 years of age; all females over 45 years of age; younger persons with medical conditions that put them at risk; and anyone concerned about their current health status. Further, these guidelines recommend *exercise testing* for: all males over 35 years of age with, or at risk of, any medical condition; all males over 45 years of age; all females over 45 years of age with a medical condition; and all females over 55 years of age.

The national lawn bowls squad has a pre-season assessment and a medical profile written by the physiology department of the Australia Institute of Sport. These assessments, suitably modified, could form the basis of a pre-participation screening program for club-level players.

6.2.1 Recommendations for further research, development and implementation

- Conduct more research into the physical well-being and anthropometric variables on which to base pre-participation screening for lawn bowls players.
- Develop a pre-participation screening program specifically for lawn bowls players.
- Promote pre-participation screening and pre-season medical assessment to bowlers.

6.3 SUITABLE FOOTWEAR

From a general review of the literature on the prevention of injuries in sport, Cross (1993) concludes that correctly fitting, suitable and safe footwear plays an important role in injury prevention.

As for all other sports, the footwear worn in lawn bowls should provide cushioning, support and stability, and must maintain reasonable flexibility, softness, and lightness (Cook et al., 1990). It is important that the material used in sports shoes allows the feet to 'breathe' to reduce moisture and prevent blisters (Cross, 1993). Tight or badly fitting shoes cause blisters, corns, loss of toenails and other foot ailments.

Balance is one of the most important factors in good bowling technique and it is also important in the prevention of injuries, particularly fall injuries. Excessive pronation (rolling) of the foot, beyond natural limits, is often a cause of instability. Hyper-pronation can be prevented by the provision of greater stability to the foot. This is achieved in sports

shoe design by including a heel counter that is firmly connected to the midsole. This wedges the midsole and is made with materials of greater consistency (firmness) than those on the lateral side (away from the midline) (Cross, 1993).

The official lawn bowls game regulations state that footwear must have rubber-soles, no heel, no grip and no spikes. This rule appears to have been framed to protect the green from damage, rather than to protect the player from slipping.

Because bowling shoes have no grip on the undersurface, extreme care is required to prevent slips and falls. This is particularly the case in wet weather when paving around the club, the green and even the mat can be slippery. Traction in wet and slippery conditions generally requires good grip on the outer sole of the shoe. Research is needed to develop a material for the soles of lawn bowls shoes which is slip resistant yet does minimal damage to the green.

6.3.1 Recommendations for further research, development and implementation

- Advise bowlers to seek professional advice when choosing bowling shoes.
- Encourage players to change their footwear to shoes with grip on the undersole when they finish bowling.
- Develop material for the undersole of lawn bowls shoes that is slip resistant yet does minimal damage to the greens.
- Investigate barriers to the use of bowling shoes with grip soles and revise rules accordingly.
- Investigate the involvement of wet greens, especially synthetic greens, in slips and falls.
- Re-design bowling mats so that they have significant grip on the top surface to provide some traction between the shoe and the mat.
- Research questions that need to be answered include:
 - Which features of footwear are protective against injuries?
 - Where should the balance lie between foot protection, the stabilising effects of footwear and flexibility of shoes?
 - What is the interaction between footwear, specific playing surfaces and injury?

6.4 USE OF A BOWLING ARM

The bowling arm is a recent innovation in the world of bowls. It is constructed in marine grade alloy with a polyester coating and weighs under one kilogram. There are two types of release mechanism, the thumb release and palm release.

The standard length arm allows players with restricted hip or back mobility to bowl without bending. It also allows players who have 'curling' fingers from rheumatism or arthritis to participate in bowls. The wheelchair length bowling arm enables people who are bound to wheel chairs to participate in the sport.

Bowls Australia has approved the use of the bowling arm at all levels of competition (Harker, personal communication).

6.4.1 Recommendations for further implementation

- Widely promote the use of the bowling arm to players with physical restrictions as a means of preventing repetitive strain injuries.
- Continue to promote participation in lawn bowls to wheelchair-bound people and those who have disabling back and hand conditions to participate in lawn bowls.

6.5 ‘NON-SLIP’ MATS

The rubber or canvas mat used in lawn bowls is small, flat and rectangular. The mat is placed on the centre line of the rink and gives players a point from which to bowl.

During social games in wet weather the bowling mat may be placed on a larger groundsheet to protect the green. Bowlers need to exercise additional care when this is done, as the top mat can slip causing the player to lose balance and fall (RVBA, personal communication).

‘Non-slip’ mats are heavily promoted. However, the advertised slip resistance refers to the felt back which holds the mat to the surface of the green. The mats have a relatively smooth rubber top that provides no traction between the bowler’s shoe and the mat. Given that regulation bowls shoes are flat-soled, it is recommended that mats should have a ridged upper surface. This innovation would need to be trialed. It may prove to be of limited benefit because the bowler generally steps forward off the mat, placing all weight and balance on the front foot on the green.

6.5.1 Recommendations for further research, development and implementation

- Incorporate a ridged upper surface in the design of ‘non-slip’ mats and test to see if the ridging protects players from slipping. If the surface provides improved protection then ridged mats should be adopted.

6.6 REMOVAL OF ENVIRONMENTAL HAZARDS

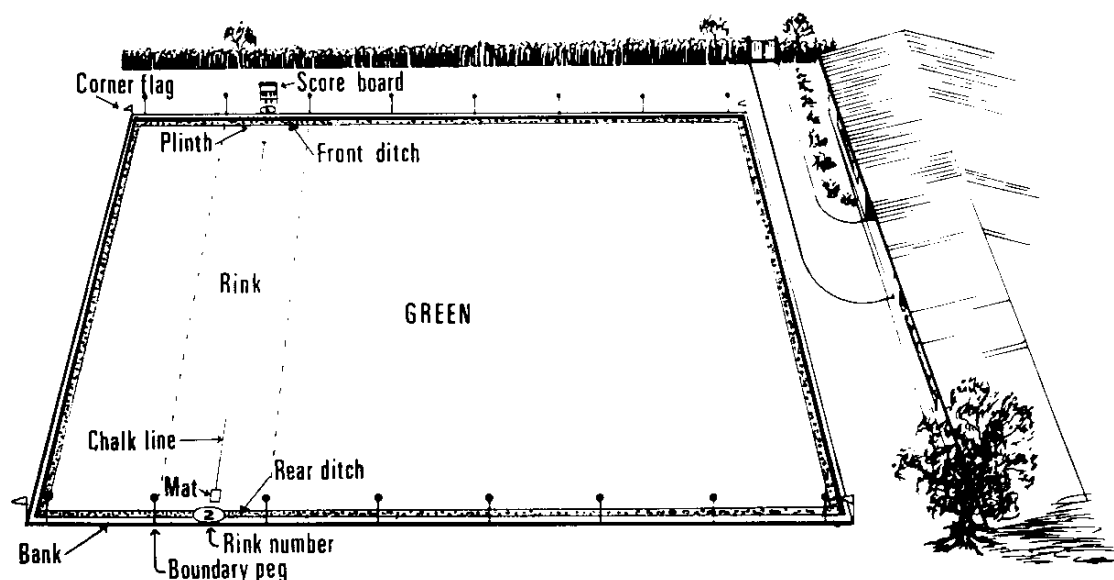
6.6.1 The green and surrounds

As previously discussed in sections 3 and 4, the available data on lawn bowls injuries (from hospital emergency department surveillance systems) showed that the green, the ditch and pathways and steps in and around club facilities present fall, slip and trip hazards to players and other users of club facilities.

Reducing the risk of falls requires a multi-faceted approach. Countermeasures could include: the provision of slip resistant steps or a ramp over the ditch onto the green; installation of hand rails around the footpaths; regular checks to ensure that footpaths do not have any cracks or loose gravel; application of anti-slip treatments to walking surfaces; the promotion of changes in footwear design to improve traction and the education of players to change out of bowls footwear when they leave the green; the provision of good lighting at night games; installation of ramps around the club house; and the provision of plenty of seating.

Every club has the responsibility to provide a safe environment for players and spectators. There are sports safety checklists available (through Sport Medicine Australia, Victorian Branch) to assist clubs to systematically assess injury risks and meet their legal duty of care. All sports clubs in Victoria are being encouraged, through the Victorian Sports Injury Prevention Program (a joint initiative of Sport and Recreation Victoria, the Department of Human Services and VicHealth), to develop and implement a Sports Safety Plan. The Plan involves the appointment of a sports safety co-ordinator or committee at the club level and commits a sporting club to a cycle of continuous improvement to promote safe participation in sport (Sports Medicine Australia 1998).

Figure 4: The bowling green and surrounds



Source: Reprinted with the permission of the RVBA

The characteristics and quality of the playing green are probably more important for lawn bowls than for any other game played on natural or synthetic turf (Gibbs, 1994). There is an increasing trend in Victoria to replace natural turf greens with synthetic playing surfaces. Synthetic surfaces reduce operating and maintenance costs and make the game less dependent on external influences (such as prevailing weather conditions and wear and tear of the green). The extent to which synthetic surfaces confer a real benefit in wet conditions is the subject of debate (Gibbs, 1994). Synthetic turfs hold water on top of the surface (a potential slip hazard) whereas natural turfs tend to absorb the excess water enabling quicker and safer return to play (Gibbs, 1994). Attention should be given to the re-design of bowls footwear to ensure that the sole material provides good traction on synthetic turfs. The comparative slip-resistance of the various natural and synthetic turfs should be a consideration when playing surface performance standards are being developed and when new surfaces are under consideration for installation.

6.6.2 Hot weather

Research has generally shown that there is a decline with age in the body's ability to adapt to variations in ambient temperature (Pandolf, 1995). This is an important consideration for the health of lawn bowls players given the older age of most bowl participants and the fact that the game is played in the open and mostly in summer.

Pandolf (1995) conducted a review of the research literature on human heat tolerance and concluded, on the weight of current evidence, that middle-aged and elderly men and women are more work heat intolerant and more susceptible to heat strain than their younger counterparts. He reported that several recent studies have found that the observed increased vulnerability of older people to work heat intolerance and heat strain may be attributed to their lack of fitness (including aerobic fitness) and to the chronic debilitating disease states that occur more frequently in the older age groups, rather than to older age per se.

The Victorian Ladies Bowling Association has invoked a rule that matches are cancelled if the ambient temperature is at 34 degrees Celsius at 12.40 p.m. on the day of play. This ruling should be considered by the RVBA for men's bowls. Alternatively, play should be scheduled for times of the day (early morning or late afternoon) when the temperature is not likely to be at extreme levels.

Impermeable clothing seriously restricts the human body's evaporative cooling mechanism (Pyke and Sutton, 1995). Open-weave cotton or woollen fibres should be worn in preference to synthetic fibres, such as nylon. Female players should be encouraged to wear socks rather than nylon stockings in hot weather. Clothing should be loose and the wearing of short sleeve shirts and shorts is also recommended. Sunscreen (SPF 15+) should be applied to all exposed areas. Adverse reactions to heat can be minimised if a hat is worn and there are frequent breaks in play for drinks. Sheltered seating areas should be available at each end of the green, for use between play.

In order to prevent the many problems associated with overheating, it is essential that the body fluid lost through sweating is replaced. During low intensity exercise, studies show that this is best achieved by a fluid replacement rate that closely matches sweat rate (Pyke and Sutton 1995). The best way of achieving this is by sipping cool water throughout play.

Playing in cold conditions is not usually an issue for lawn bowls players, because the game is played mostly in the warmer months. In extreme weather conditions social games are usually cancelled to protect the green. However, during tournaments a game is called off

only if both team managers agree. If they cannot agree then an appeal is made to the umpire who makes the final decision. By contrast, greens managers can decide to call off a game at any time if they believe the surface of the green is being damaged.

6.6.3 Recommendations for further research, development and implementation

- Develop, implement and monitor risk management plans for bowling facilities to control environmental hazards.
- Reduce the risk of injurious falls in lawn bowls through a multi-faceted approach which could include:
 - the provision of slip resistant steps or a ramp over the ditch onto the green;
 - the installation of hand rails around the footpaths;
 - regular inspection and repair of footpaths;
 - application of anti-slip treatments to walking surfaces;
 - the promotion of changes to bowls footwear to improve its slip resistance and education of players to change out of bowls footwear when they have finished playing;
 - the provision of good lighting at night games;
 - the installation of ramps around the club house; and
 - the provision of plenty of seating.
- Introduce a consistent rule that restricts play in extreme weather conditions.
- Educate players to sip water throughout the game, especially in hot weather, to ensure adequate hydration.
- Promote the use by players of a broad spectrum sunscreen even on cloudy days.
- Advise players to keep undergarments to a minimum in hot conditions.
- Undertake studies to determine the influence of environmental conditions, such as playing surface and weather conditions, on injury.
- Conduct research on the interaction between footwear, specific playing surfaces and injury.

6.7 BOWLS AND BAGS

Lawn bowls come in a set of four and are available in nine sizes (size 00-7) to fit the hand size of players. The use of the correct-size bowl is important not only for good playing technique and control, but also to prevent bowls slipping from the hand which may cause injury. Many retailers have a special gauge for measuring the bowler's hand size. However, the most common method used by players is to place the two thumbs together on the centre of the running surface and to span the hand around the bowl. If the two middle fingers just meet

then the bowl is the correct size. The most important factor in choosing a set of bowls is that the bowl should feel comfortable in the hand. Bowls come in standard and heavy weight, and can be selected with standard or minimum bias. Each set of bowls has a different design or mark engraved which distinguishes each player's bowls during the match.

Carrying bowling bags can also be a strain for some players because of the weight of the bowls. Strain is reduced if the bowls are evenly distributed across the bag when they are packed away (RVBA, personal communication). Any player who has difficulty lifting and carrying a bowls bag should use a trolley.

6.7.1 Recommendations for further research, development and implementation

- Players should seek professional advice when purchasing bowls.
- As players get older they should review the weight and size of their bowls.
- Players who have difficulty lifting their bowls bag should use a trolley.

6.8 APPROPRIATE PHYSICAL PREPARATION

Participants in sport and physical activities need to meet at least minimum physical, physiological and psychological requirements to cope with the demands of competition and reduce the risk of injury (Australian Sports Injury Prevention Taskforce, 1997). Pre-participation screening can determine whether players have any physical weaknesses that may pre-dispose them to injury. Recommended remedial actions from screening should be implemented. Individual player factors that may increase the risk of injury can usually be remedied through corrections to technique and appropriate physical preparation.

6.8.1 Warm-up and stretching

“Warm-up” is a term which covers the light exercise, stretching and psychological activities that are undertaken just prior to sporting activity to increase ‘readiness (Garrett, 1993). Warm-up to a light sweat followed by slow and relaxed stretching, immediately prior to exercise, are generally recommended to athletes as a means of enhancing performance and reducing the risk of musculotendinous injury, particularly muscle tears (Safran et al 1989).

Safran et al (1989) and Best and Garrett (1993) concluded, from their respective literature reviews, that there is a body of physiological evidence that shows that warm-up removes some of the physical stresses associated with exercise. Warm-up and stretching have been shown in laboratory studies to improve the range of motion of the joints, increase muscle, ligament and tendon elasticity (thus requiring a greater force and degree of lengthening to tear muscle) and promote heat transfer (Safran et al 1989; Best & Garrett 1993).

On the basis of current clinical and experimental evidence, Safran and his colleagues were prepared to recommend that warm-up and stretching routines were essential to the prevention of muscle injuries in sport. Best and Garret (1993) were more guarded. They concluded, on the basis of information currently available, that it was ‘reasonable to accept’ that warm-up may play a role in the reduction of the incidence and severity of musculoskeletal injuries. Both groups of researchers recommend that well-controlled epidemiological and experimental studies are needed to fully evaluate the proposition that warming-up aids injury prevention.

McGrath and Finch (1996) recently reviewed published studies on the effectiveness of warm-up and stretching as a countermeasure to running injuries and found that the epidemiological evidence of a protective effect was inconclusive. In fact, the weight of research evidence suggested that warm-up and stretching had either no effect or a negative effect on the risk of sustaining a running injury. However, the authors alluded to a number of methodological weaknesses in the studies they reviewed, particularly the lack of information on the type and duration of the warm up, cool down and stretching routines used by participants. They suggested a possible explanation for the conflicting evidence is that some warm-up regimes and practices protect against injury while others do not (or may even cause injury).

Rigorous controlled trials are obviously required to determine whether warm-up, stretching and cool down routines are effective injury prevention measures. These trials should also address such issues as the optimal time for warm up and cool down, whether individualised programs are needed for players in different age and sex groups and whether customised warm-ups are required for different sports.

The National Lawn Bowls Manual for Coaches (Williams and Pynt, undated) recommends that all players – particularly those affected by stiffness – perform light preparatory exercises to improve flexibility before competition. The manual offers examples of appropriate stretching activities. Some players have expressed concern to the RVBA that the recommended exercises may not be suitable for all players and may lead to injury or re-injury, especially among older bowlers (RVBA, personal communication). Therefore, it is recommended that individual players seek professional medical advice on an appropriate warm-up session. Clearly, warm-up and stretching should not unduly strain or tire the athlete.

The RVBA reported that most of the locally available promotional material on warm-up for bowls players was developed in conjunction with the Victorian Arthritis Foundation (RVBA, personal communication). This partnership may have led players who do not have arthritis to assume that warm-up is not an issue for them. It is recommended that carefully structured and tailored warm-up routines should be promoted to all players (on the assumption that they may be useful and that they cause no harm).

6.8.2 Training

A number of sports science experts have addressed the role of training programs in injury prevention. According to Best and Garrett (1993) there is little doubt that inappropriately designed training programs are major contributors to injury. Cross (1993) states that adequate physical fitness is an essential pre-requisite for participation in any sport because fatigued athletes have decreased skills performance that can lead to injury. Physical fitness is important for lawn bowlers who can be assisted to attain optimal levels for the sport through regular practice and exercise (Williams and Pynt, undated).

Cross (1993) asserts that with today's sophisticated physiological research and communication, it should be possible for a training program to be designed that is specifically tailored to optimise performance in a particular sport. In order to devise efficient and safe training programs, coaches (in consultation with players) need to consider the capabilities of the individual players in their charge and the physical requirements of the sport.

It is currently accepted that a good training program should include: a warm-up and stretching period; gradual increases and variation in training intensity, frequency and duration; drills specific to the sport; a time for cool-down and stretching after exercise; and adequate rest and recovery periods (Elam, 1986; Cross, 1993).

Mental fatigue is a risk factor for injury and is associated with lack of fitness (Williams and Pynt, undated). It is recommended that players make full use of rest periods between games to aid recovery and prepare psychologically for the next game.

The national elite lawn bowls squad undergoes a fitness training program twice a year in Canberra. A modified version of the squad's training program could be adapted for social and competitive players and widely promoted.

6.8.3 Cool down

Stretching and 'cool-down' after exercise may have more physiological benefits than warm-up. Cooling down provides optimal recovery from strenuous exercise but there is little research evidence to show that cooling down reduces the incidence of injury (Best and Garrett, 1993).

Gibbons et al (1989) suggest that cooling down activities may reduce the risk of exercise-related cardiovascular complications in older people. They reported from their research that only 6 exercise-related cardiovascular complications occurred during a total of 71,914 exercise tests in 34,295 participants (mostly healthy, young and very fit adults) but that the majority of the complications were in older participants, and those with illnesses, during the recovery period from exercise.

6.8.4 Recommendations for further research, development and implementation

- Develop current best practice information about warm-up, cool-down and stretching techniques for lawn bowls. These exercise routines should be widely promoted through the RVBA, clubs and the Arthritis Foundation.
- Conduct simple fitness testing prior to each lawn bowls season to ensure players are fit for competition.
- Introduce training sessions to improve fitness and for skills development.
- Educate players about the nutritional and hydration demands of playing lawn bowls, particularly in hotter climates and warmer weather.
- Skills and fitness should be built-up gradually during the period when a player is learning the sport.
- Investigate the role of warm-up, cool-down and training as injury prevention measures for lawn bowls and the relative benefits of different types of warming-up, cooling-down and stretching practices.

6.9 EDUCATION OF COACHES AND TRAINERS

Education about injury prevention should cover a wide range of aspects such as training, treatment of injury and safety of playing facilities (Damoiseaux & Kok, 1993). The

overwhelming majority of experts interviewed by Egger (1990) rated education, particularly of coaches and trainers, as having a major role in injury prevention.

Coaches have the responsibility for training athletes through analysing their performances, instructing players in relevant skills and providing encouragement (Australian Sports Commission, 1997). Coaches also need to be educated in first aid. Every club committee has a duty to ensure that all members, including social bowlers, have access to proper instruction to improve standards and develop their full potential (Williams and Pynt, undated).

The *National Lawn Bowls Manual for Coaches* (Williams and Pynt, undated) indicates that coaches should have a good knowledge of the game and the ability to:

- communicate
- educate
- lead
- organise
- observe
- motivate
- evaluate

Coaches should also take responsibility for injury prevention. There are three levels of coaching courses run for lawn bowls (orientation to coaching, level 1 and level 2). There are 1,382 accredited lawn bowls coaches in Victoria.

6.9.1 Recommendations for further development and implementation

- Each club committee should appoint at least one well-respected and advanced bowls player to act as club coach.
- All coaches should be accredited and undergo regular training and re-accreditation.
- Coach education schemes should be updated regularly to ensure they provide current information.
- The coaching manual should be reviewed to include more information on sports injury prevention, treatment and rehabilitation.
- Prevention of injury should be a key responsibility of coaches and the subject should be included in the coaching manual.
- Educational resources for social lawn bowls players need to be developed and disseminated.
- Instruction clinics for the social bowler should be developed and advertised widely.

6.10 PREVENTING OVERUSE INJURIES

Repetitive movements, such as those practised in lawn bowls, can cause overuse injuries. An overuse injury results from an accumulation of stresses on the tissue involved: bone, ligaments, muscles or tendons. The tissue and anatomical sites of an overuse injury may vary but according to Herring and Nilson (1987) the cause is still the same: repetitive episodes of trauma overwhelming the body's ability to repair itself.

Overuse injury can be caused by the forces and repetitive nature of bowl delivery or a previous injury for which the body compensates by increasing the stress on another part of the body. The process of compensation eventually leads to tissue breakdown and overt injury at the vulnerable site.

It has been reported that inflammatory overuse injuries are more common than acute injuries in elderly athletes (Kallinen and Markku, 1995). Overuse injuries among older athletes must be taken seriously. They should not be viewed as a natural outcome of the ageing process.

Kallinen and Alen (1994) reported from their study of elderly male athletes aged 70 to 81 years that 34% of the overuse injuries could not be located in any specific tissue. This suggests that overuse injuries are more diffuse in nature in older athletes and may be related to the degenerative aging process (Kallinen and Markku, 1995). The high proportion of overuse injuries connected with degenerative processes means that the follow-up treatment for complaints may go on for longer among elderly athletes (Kallinen and Markku, 1995). Older athletes may also defer seeking medical advice, believing the injury is purely part of the ageing process. Also, health care professionals occasionally adopt a negative attitude to sports participation among the elderly and advise those with chronic injuries to give up the sport.

To minimise the risk of overuse injury among lawn bowls players, limitations should be placed on the frequency and duration of repetitive movements. Breaks in the activity should be taken and ergonomic assessments should be made. Inadequate or inappropriate playing technique, training, warm-up, conditioning and rehabilitation are factors that contribute to the risk of overuse injury. Therefore, reference needs to be made to all the countermeasures relevant to these aspects reviewed in this report.

6.10.1 Recommendations for further research, development and implementation

- Investigate the role of conditioning (to improve strength and flexibility) in the prevention of overuse injuries.
- Educate lawn bowlers about the risks and potentially severe consequences of overuse injuries.
- All lawn bowls players should practise appropriate warm-up and stretching routines prior to games and cool downs after games.
- Undertake research into the frequency, patterns and causes of overuse injuries among lawn bowlers.

6.11 APPROPRIATE FIRST AID AND REHABILITATION

Injuries need to be properly managed to promote healing and to reduce the risk of further damage. The treatment goals are: pain relief; promotion of healing; decreased inflammation; and return to full function and sporting activities as soon as possible. This process may involve first aid, taping or bracing of the injured body part and referral for expert treatment and general rehabilitation.

Given the older average age of lawn bowlers, many injuries in bowls are likely to be aggravations of existing injuries or re-injuries. Recovery from injury is far slower in older people than in young people and surgery is an unappealing option because it generally includes a long period of rehabilitation (Australian Sports Medicine Federation, undated). Complete and controlled rehabilitation of an injury needs to be achieved, and sensible precautions taken to prevent re-injury, before the injured person returns to full play.

6.11.1 Sports first aid

Rest, ice, compression, elevation and referral (RICER) is a well known procedure for the initial management of injury. This treatment regime is believed to reduce the risk of exacerbating the injury; decrease haematoma, swelling and the amount of tissue damage; and speed recovery (Knight, 1985; Larkins, 1990; National Sports Trainers Scheme, 1994).

Although this procedure is well recognised and widely used, there have been no recent studies on its effectiveness. Nevertheless, it is widely promoted as good first aid practice and its effectiveness is generally accepted.

Sports Medicine Australia (SMA) in its *Sports First Aid Course* provides guidance on the RICER technique (National Sports Trainers Scheme, 1994). Unfortunately, the *National Lawn Bowls Manual for Coaches* (Williams & Pynt, undated) does not include a section dealing with first-aid. According to the RVBA all bowls club in Victoria have first aid kits and a large number have a respirator (RVBA, 1998). It is strongly recommended that at least one trained first aider is on duty at all times during competitive and social bowls events.

6.11.2 Taping and bracing

Ankle inversion sprain is one of the most common sports injuries. It is generally believed that taping and bracing of a joint helps to reduce the range of movement at the joint and, therefore, reduces the risk or severity of injury (National Sports Trainers Scheme, 1994). However, the research evidence that taping and bracing have a protective effect is inconclusive (Hume and Gerrard, 1998; Robbins & Waked, 1998). Ankle taping and bracing are generally considered to be components of the management and rehabilitation process for ligament injuries but prophylactic (preventive) taping and bracing is becoming more common in sports that have high rates of ankle inversion injury such as netball and basketball.

It is probable that lawn bowls is a low risk sport for ankle inversions because the sport does not involve running, sudden change of directions or landing from a jump (Hume and Gerrard, 1998). For this reason the discussion in this section will be limited to current evidence on the protective effect afforded by taping and bracing on ankles 'weakened' by a history of previous injury.

Hume and Gerrard (1998) recently reviewed research studies on the effectiveness of external ankle support. The authors concluded that, although the evidence remains equivocal, there are several epidemiological studies that indicate that taping and bracing may be effective in reducing the frequency of ankle inversion injuries, particularly among athletes with previous ankle injury.

Studies in the review that showed that taping is protective against re-injury included: an early randomised controlled study of 2,562 U.S. intramural university basketball players by Garrick and Requa (1973) conducted prospectively over two seasons (although the number of injured players in the study groups were small); and a retrospective study covering six seasons of collegiate football practices and games in the US conducted by Rovere, Clarke and Yates (1988). The design of the latter study was weakened by a lack of a comparison group with unsupported ankles and the non-randomised assignment of ankle supports (tape and braces).

Hume and Gerrard (1998) reported on several controlled studies that have shown that ankle braces protect against ankle re-injury. The strongest study, a large prospective randomised controlled trial on the effectiveness of a semi-rigid ankle stabilisers (involving 1,601 healthy US Military Academy cadets playing basketball) was conducted over two seasons by Sitler et al (1994). The study found that semi-rigid ankle stabilisers significantly reduced the frequency, but not the severity, of acute ankle injuries in both the non-injured ankle group and previously injured ankle group. Studies on soccer players by Tropp et al (1985) and Surve et al (1994) also report that ankle orthosis (braces) when used by players with previous ankle injury protected against re-injury. The latter study, a randomised controlled trial of the effectiveness of a particular brand of semi-rigid orthosis that involved 258 senior soccer players with previously injured ankles and 246 uninjured players, found a fivefold reduction in the incidence of recurrent ankle sprains in soccer players using the orthosis.

These studies consistently showed that the effectiveness of the external ankle support is dependent on the material properties and application method of the tape or brace and the innate stability and previous injury status of the athlete's ankle (Hume and Gerrard, 1998). Also, players with previous ankle injury were shown to be more at risk of re-injury than players with no prior history of ankle injury irrespective of whether they taped and/or braced their vulnerable ankle/s (Hume and Gerrard, 1998).

Of note is a contrary view on the value of taping and bracing put forward in recent review by Robbins and Waked (1998). On the basis of published studies on barefoot and shod subjects and physiological evidence, the authors contend that ankle injuries are not caused by any innate structural weakness in the ankle but by decreased foot position awareness (proprioception) caused by sports footwear. They theorise that if taping and bracing devices do protect the ankle (and they are not convinced by current evidence) it is because they restore tactile cues of foot position (through skin pressure or skin traction). This enables shod players to better judge foot position and orientation when making contact with surfaces. The authors recommend taping over bracing because of the research that shows taping interferes least with normal movements but they contend that the best solution to ankle inversions is thinner and firmer soled sports footwear that heighten the wearer's awareness of foot position.

On the weight of current evidence it would appear that lawn bowls players who have a history of ankle sprain injuries should seek a sports medicine professional's advice on a suitable ankle orthosis (brace) or learn to tape the ankle. The disadvantages of taping include the expense, inconvenience and the diminution of support for the ankle after 20-40

minutes of active movement (although this loss of support may not apply in lawn bowls which is a relatively sedentary activity).

6.11.3 Rehabilitation

Returning to play too early after an injury can make the player susceptible to re-injury. The coach should make sure that the risk of re-injury is reduced by monitoring that players only return to play when fully rehabilitated. The coach should also monitor that recommended warm-ups are practised and appropriate taping and bracing is used, if recommended. Muscle stretching exercise routines before play may assist in preventing injury.

Kallinen and Markku (1995) report that once a sports injury is diagnosed in an elderly athlete, an active progressive rehabilitation program must be put into operation. Anti-inflammatory medication and physiotherapy are the usual treatments for injuries among older athletes. Surgery is the last resort for chronic overuse and other serious injuries. Taping, various kinds of bandages and other aids are usually necessary in the late rehabilitation phase of the treatment of sports-related injuries among elderly athletes.

A rehabilitation program must not be regarded as completed until the athlete is free from pain, muscle strength has returned to near pre-injury level and articular mobility (joint union movement) has recovered to the pre-injury level.

Older athletes should not view persistent injuries as a natural part of “getting on a bit”. A qualified sports medicine professional should be consulted promptly for expert diagnosis and advice on treatment and rehabilitation (Australian Sports Medicine Federation, undated).

6.11.4 Recommendations for further research, development and implementation

- At least one qualified first aider should be on duty at all bowls events.
- All bowling clubs should have a well-stocked first aid kit, telephone and emergency contact numbers on display.
- Return to play after injury should only occur after full recovery.
- More controlled research is needed to determine the effectiveness of taping and bracing of body joints, for example the ankle, as a primary prevention injury countermeasure.

7. CONCLUSION

There is a notable lack of data from Victoria or elsewhere on the frequency, patterns and risk factors for lawn bowls injuries. Data from hospital emergency department surveillance systems reveal that presentations for lawn bowls injuries are uncommon. This is probably explained by the lower physical intensity of bowls compared with other sports. The small number of injury cases that present annually to hospital emergency departments in Victoria, Australia and New Zealand were mostly due to falls on and around the green and in and around club facilities. Older people, especially older women, are particularly vulnerable to fall-related fractures that can cause longer-term disability and reduce quality of life and independence. Because of the older age of participants in lawn bowls, clubs and associations need to be vigilant about eliminating fall hazards from the game and the playing environment.

Anecdotal evidence and findings from research on other groups of older athletes suggest that injuries among lawn bowls players are more likely to be intrinsic in nature – sprains, strains and joint problems. Generally, these sports injuries are not well-captured by hospital emergency department injury data collections. Players with intrinsic injuries are more likely to consult general practitioners, other health professionals (for example physiotherapists and chiropractors) or self-manage their injuries. Because there are no comprehensive injury data collections from general practitioners and the other health professionals that treat sports injuries, there is a pressing need for bowls clubs and associations to collect player injury data.

8. REFERENCES

- Adams WC. Exercise and aging. In: Adams WC, ed. Foundations of physical education, exercise and sports science. Philadelphia: Lea and Febiger, 1991:213-227.
- Åstrand PO. Why exercise? *Medicine and Science in Sports and Exercise* 1992;24(2):153-162.
- Australian Bureau of Statistics. Mortality tabulations (class XVII deaths, Vict., by age group and sex). microfiche 1993.
- Australian Bureau of Statistics. Participation in sport and physical activities. 1997.
- Australian Bureau of Statistics. Population survey monitor database. 1993/94 and 1995/96.
- Australian Sports Commission. Sports coaching. <http://www.ausport.gov.au/coach.html> 1997.
- Australian Sports Injury Prevention Taskforce (ASIPTF). Sportsafe Australia, 1997 (unpublished).
- Australian Sports Medicine Federation. Safe veterans sport: guidelines for safe participation in veterans sport. Australian Sports Medicine Federation, undated.
- Baker SP, Harvey AH. Fall injuries in the elderly. *Clinical Geriatric Medicine* 1985;320:1055-1059.
- Backx FJG. Sports injuries in youth: Aetiology and prevention. 1991
- Best TM, Garrett WE. Warming up and cooling down. In: Renström PAFH, ed. Sports injuries: basic principles of prevention and care. London: Blackwell Scientific Publications, 1993:242-251.
- Brasch R. How did sports begin? Camberwell: Longman, 1971.
- Brooks P. Bending for bowlers. Adelaide: Arthritis Foundation of South Australia, 1991.
- Campbell AJ, Robertson MC, Gardner MM, Norton RN, Tilyard MW, Buchner DM. Randomised controlled trial of a general practice programme of home based exercise to prevent falls in older women. *British Medical Journal* 1997; 9:112-119
- Coaching tips for the new bowler. <http://www.chariot.net.au/daryls/coach.htm> 1997.
- Cook SD, Brinker MR, Pache M. Running shoes: The relationship to running injuries. *Sports Medicine* 1990;10(1):1-8.
- Cross MJ. General prevention of injuries in sport. In: Renström PAFH, ed. Sports injuries: basic principles of prevention and care. London: Blackwell Scientific Publications, 1993:334-342.
- Damoiseaux V, Kok G. Principles of health education. In: Renström PAFH, ed. Sports injuries: basic principles of prevention and care. London: Blackwell Scientific Publications, 1993:343-352.
- DeCastella R. Forward. In: Brooks P, ed. Bending for bowlers. Adelaide: Arthritis Foundation of South Australia, 1991:
- Egger G. Sports injury in Australia: Cause, cost and prevention. *Health Promotion Journal of Australia* 1991;1(2):28-33.

- Elam IBG. Warming up and cooling down. In: Renström PAFH, ed. Sports injuries: basic principles of prevention and care. London: Blackwell Scientific Publications, 1993:242-251.
- Gibbons L, Blair SN, Kohl HW. The safety of maximal exercising testing. *Circulation* 1989;80:846-852.
- Gibbs R. Inconsistencies with the standard of international bowling greens. *Turf Craft Australia* 1994;September:14-16.
- Haddon W. A logical framework for categorizing highway safety phenomena and activity. *Journal of Trauma* 1972;12:197-207.
- Hardman AE. The benefits of low intensity exercise. In: Norgan NG, ed. Physical activity and health. 34th Symposium Volume of the Society for the study of Human Biology. Cambridge: Cambridge University Press, 1992:143-159.
- Hersham (1984) In: Backx FJB. Sports injuries in youth: Aetiology and prevention. 1991.
- Herring SA, Nilson KL. Introduction to overuse injuries. *Clinical Sports Medicine* 1987;6:225-239.
- Hume PA, Gerrard DF. Effectiveness of ankle support: Bracing and taping in Rugby Union. *Sports Medicine* 1998;25(5): 285-312.
- Kallinen M, Markku A. Ageing, physical activity and sports injuries: An overview of common sports injuries in the elderly. *Sports Medicine* 1995;20(1):41-52.
- Kallinen M, Alen M. Sports related injuries in elderly men still active in sports. *British Journal of Sports Medicine* 1994; 28:52-55.
- Kallman H, Kallman S. Accidents in the elderly population. In: Reichel W, ed. Clinical Aspects of Ageing. 3rd ed. Baltimore: Williams and Wilkins, 1989:546-558.
- Kamien M. A rational management of tennis elbow. *Sports Medicine* 1990;9(3):173-191.
- King MB, Tinetti ME. A multifactorial approach to reducing injurious falls. *Clinics in Geriatric Medicine* 1996;12(4):745-759.
- Larkins PA. Common running problems. Canberra: Australian Sports Medicine Federation, 1990.
- Lowdon BJ, Pateman NA. Elderly competitive athletes. *Australian Journal of Sports Medicine*. 1980; 12(4):7-12.
- McGrath A, Finch CF. Running the race against injuries: A review of the literature. Monash University accident Research Centre, 1998: Report No. 130.
- National Sports Trainers Scheme. Sports first aid course manual. Australian Sports Medicine Federation, 1994.
- Oxley J, Fildes B, Ozanne-Smith J, Day L. Injuries and falls among older people. In: Fildes B, ed. Injuries among older people. Falls at home and pedestrian accidents. North Blackburn: Collins Dove, 1994:7-41.
- Ozanne-Smith J, Vulcan P. Injury control. In: McNeil J, King R, Jennings G, eds. A textbook of preventive medicine. Melbourne: Edward Arnold, 1990:
- Pandolf KB. Aging and human heat tolerance. *Experimental Ageing Research* 1997; 23(1):69-105.
- Pescatello LS, DiPietro L. Physical activity and older adults: An overview of health benefits. *Sports Medicine* 1993;15(6):353-364.

- Pyke FS, Sutton JR. Environmental stress. In: Bloomfield J, Fricker P, Fitch K, eds. *Science and Medicine in Sport*. 2nd ed. Australia: Blackwell Science, 1995:129-149.
- Robertson L. *Injuries, causes, control strategies and public policy*. Lexington (MA): Lexington Books, 1983.
- Rovere GD, Clarke TJ, Yates CS et al. Retrospective comparison of taping and ankle stabilizers in preventing ankle injuries. *American Journal of Sports Medicine* 1988;16(3):228-33.
- Royal Victorian Bowls Association (RVBA). *In the groove*. Melbourne: Royal Victorian Bowls Association, 1995.
- Safran MR, Seaber VV, Garrett WE. Warm-up and muscular injury prevention (an update). *Sports Medicine* 1989;8(4):239-249.
- Sitler M, Ryan J, Wheeler B et al. The efficacy of a semi-rigid ankle stabilizer to reduce acute ankle injuries in basketball. A randomized clinical study at West Point. *American Journal of Sports Medicine* 1994;22(4):454-61.
- Sports Medicine Australia. *How to become a sports safe club: Guidelines for developing and implementing a sport safety plan*. 1998.
- Surve I, Schweltnus MP, Noakes T, Lombard C. A fivefold reduction in the incidence of recurrent ankle sprains in soccer players using the Sport-Stirrup orthosis. *American Journal of Sports Medicine* 1994;22(5):601-606.
- Tinetti ME, Speechley M. Prevention of falls among the elderly. *New England Journal of Medicine* 1989;320(1055-1059).
- Tropp H, Askling C, Gillquist J. Prevention of ankle sprains. *American Journal of Sports Medicine* 1985;14(4):259-262.
- van Mechelen W, Hlobil H, Kemper HCG. *How can sports injuries be prevented?* NISGZ publication no 25E, Papendal The Netherlands 1987.
- Williams B, Pynt G. *National Lawn Bowls Manual for Coaches. Advanced Teaching*. Bowls Australia National Coaching Committee in conjunction with the State Coaching Panels, undated.
- Wolf SL, Barnhart HX, Kutner NG, McNeely E, Coogler C, Xu T. Reducing frailty and falls in older persons: an investigation of Tai Chi and computerized balance training. *Journal of American Geriatrics Society* 1996;44:489-497.
- Wolf SL, Barnhart HX, Ellison GL, Coogler C. The effects of Tai Chi Quan and computerized balance training on postural stability in older subjects. *Physical Therapy* 1997;77(4):371-381.