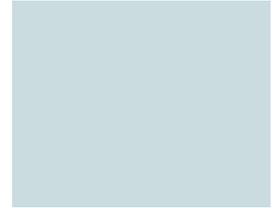


Ground conditions and injury risk – Implications for sports grounds assessment practices in Victoria

Summary Report





Background

Over recent years, questions about the suitability of grounds for sporting activities have risen to the fore, particularly with ongoing drought conditions. Naturally, sporting bodies and local governments have reacted to this prominence and begun to ask questions about the suitability of their grounds for sporting activities; how they should go about assessing them; and what they should do to address any identified safety concerns.

Intuitively, ongoing drought conditions have an impact on the condition of playing fields. Unfortunately, in the absence of clear evidence-informed validated guidelines, ground managers, Local Government Authorities (LGAs) and State Sporting Associations (SSAs) and their clubs are making decisions about the suitability of a turf sports ground for sport based solely on anecdotal evidence and supposition of the increased risk of injury. This has led to a range of actions and decision making criteria that may be hard to defend formally. Moreover, the lack of solid evidence to support the claims being made currently limits the advice that can be provided to LGAs, SSAs and clubs about grounds management and safety risk.

In 2005, the Sport and Recreation Victoria (SRV) Division of the Department for Victorian Communities, commissioned a study by the University of Ballarat to review and evaluate issues relating to turf sports ground and surface conditions and their possible relationship to sports safety.

This document is an edited summary of the outcomes of the study. A copy of the full report is available from SRV's website at www.sport.vic.gov.au

About the study

The investigation by the University of Ballarat included a critical review and evaluation of the standards and related guidelines and practices currently used by turf-based sports and ground managers to assess ground safety and injury risk, as well as an investigation of the current evidence relating to relationships between ground conditions and injury risk.

The current scientific evidence linking ground conditions to injury risk and the details of where gaps in current knowledge exist are summarised in List 1 and 2 respectively.

List 1: What is known about ground and surface conditions as a risk factor for sports injury?

- The evidence linking ground and weather conditions to sports injury risk comes from studies of elite, professional or semi-professional footballers, across all codes.
- The major characteristics of ground surface that need to be considered are ground hardness and traction. The current evidence for a link between ground hardness and injury risk is equivocal.
- A risk management approach to removing and controlling ground condition hazards needs to include factors such as:
 - the presence of hazards and debris
 - unevenness of the ground
 - the type of surface, and
 - ground conditions and the impact of weather conditions.



- There is generally an early-season bias in the occurrence of football injuries, which may be related to harder ground conditions or greater shoe-surface traction at the start of the season in countries such as Australia, but other factors such as:
 - player fitness/conditioning
 - training schedules; and
 - the speed of the gameare just as likely to be important.
- Circumstantial evidence suggests that it is highly likely that variations in ground conditions are responsible, at least in part, for the early-season bias in football injuries.
- The incidence of lower limb injuries may be more related to shoe-surface traction than to ground hardness.
- There is a suggestion of an increase risk of lower limb injuries on Astroturf, compared to natural grass.
- In elite AFL competitions, there appears to be an association between the type of grass and injury rates, particularly for ACL injuries
- Although injuries occur in both formal game settings and training sessions, the relationships with ground and weather conditions are likely to be different for the different type of activity.

List 2: What is not known about ground and surface conditions as a risk factor for sports injury?

- The relationship between injury risk and ground conditions in sports other than the football codes. (There have been no published studies in cricket, hockey or netball. In Australia, apart from one study in semi-professional rugby league, all other data relating injuries and ground conditions comes from the elite AFL competition).
- The extent to which, if at all, the studies in elite, professional or semi-professional football are directly relevant to community and junior football, let alone other sports.
- The extent to which studies conducted overseas (e.g. in soccer and rugby union) can be directly applied to the sporting ground context in Australia.
- The nature of the direct relationship, if any, between ground conditions and injury risk in most sports. The relationship, from football studies, is largely speculative and based on correlational data only. Most studies have not directly measured ground conditions with validated tools.
- The causal pathways and mechanisms by which ground conditions potentially influence injury risk, except perhaps for ACL injuries.
- The extent to which the early-season bias for football injuries can be explained by player fitness and conditioning factors, rather than ground conditions.

So is there a relationship between extremes in surface conditions and injury?

Intuitively, there is a relationship between extremes in surface conditions and injury. However, other factors could also play a role in injury risk such as the speed of the game, poor conditioning of players in the early part of the season and the types of boots worn.

The equivocal and rather patchy evidence linking injury risk to ground conditions leads naturally to the question as to what are the important ground condition features that LGAs, SSAs and their clubs should be most concerned about.

The ground condition features considered in the report are:

- above/on grounds hazards checks,
- hardness,
- rotational traction (grip),
- shear traction,
- soil moisture content,
- grass type and coverage, and
- weather.

Commonly, these features are measured with items such as match day checklists, Clegg Hammers, torque wrenches, soil moisture devices and grass/soil samples.

Unfortunately, not all of this equipment is directly available to, or within budget constraints of most LGAs or SSAs/clubs themselves. In such situations, the report provides suggestions for how to source the testing methods and relevant experts.

The focus of the discussion in the report, is on the assessments that LGAs and SSAs/ clubs could reasonably be expected to perform on a regular basis. The recent

development of more detailed observational checklists, such as those used under the banner of **Derived Score Methods (DSM)**, have the potential to lead to more reliable observational assessments in the future and could avoid the need for expensive equipment.

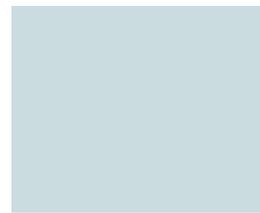
However, the DSM checklists and guidelines require further development and validation before their use can be widely advocated. Importantly, the value of sports ground inspections as a factor in promoting ground safety depends upon the quality and comprehensiveness of the 'measurements' used and more critically on the actions taken to address the issues identified.

With this information as background, the current practices of a selection of Victorian SSAs (Australian Rules football, cricket, football (soccer) and hockey) and LGAs was assessed by the University of Ballarat.

The current practices of a selection of Victorian sports and local governments

The use of match day checklists, often as developed and advocated by insurance companies, appears to be well accepted by SSAs, which promote them widely across all levels of their sport. In contrast, the level of ground assessment was not high amongst LGAs.

Of the 47 LGAs that responded to a survey by the University researchers, almost half (49%) did not have a policy or guideline related to sports ground safety or suitability for play. Some LGAs initiated a co-operative approach with clubs to support sports ground safety and this is seen as good practice.



Both LGAs and SSAs have a hierarchy whereby their more direct and detailed involvement in ground assessments exists for higher levels of the game than for community or junior participation. Sports grounds that supported better standards of play, or finals, are generally regarded as showpieces and therefore allocated better maintenance and turf management regimes. Similarly, and perhaps surprisingly, these grounds were also assessed for safety far more regularly and comprehensively than community grounds.

Published assessments of ground conditions

All of the published assessments of ground conditions have been made on elite or high performance football fields, largely during the months of the football season and only in relation to the elite or professional level of the sport.

It is important to note that the described set of conditions from elite venues cannot necessarily be applied directly to all venues that host Australian football games at other levels of play, nor to other sports because those venues operate under different financial limitations, water availability, usage patterns, and so on.

The report prepared by the University provides new data describing ground conditions that could be considered as “representative” for Australian Rules football played at metropolitan, regional and rural levels over a 12-month period, encompassing both football season and non-football season periods. It therefore provides some information about ground conditions for other sports using those fields outside of the March to September period.

However, as only one 12-month period is covered, caution needs to be used when interpreting these data, as ground and weather conditions could be quite different in other years.

As would be expected, due to annual trends in weather and other environmental factors over a 12-month period, there were significant differences for all of the measured variables between the various dates of assessment.

Generally, ground conditions were less optimal in regional and rural grounds, compared to their metropolitan counterparts.

A formal assessment of a match day checklist and a DSM checklist was also made against a range of objective measures on a sub-set of the above football fields to provide an evaluation of the value of the DSM.

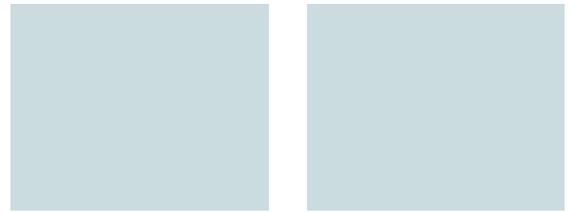
When assessed over time, the overall DSM scores were consistent with a deterioration of the ground conditions, reflecting increasing drought conditions and the wear and tear of a football season.

Conclusion

The report highlighted significant limitations in both the evidence base linking injuries to ground conditions and in the reliability/validity of currently available measurement methods. Notwithstanding these limitations, the researchers suggest that LGAs and SSAs/clubs could, and should, assess the conditions of their grounds on a regular basis.

Ideally, grounds should be assessed using fully objective measures but it is recognised that the necessary equipment is expensive and requires “experts” to use it effectively.

Recommendations



Recommended good practice

A two tiered approach to sports ground safety and suitability for play is recommended in the report as good practice.

The first tier would involve pre-game and pre-training inspection of the sports ground for hazards that are likely to cause injury. This process should be conducted by individual clubs before all training sessions and by both clubs prior to the first use of the ground on match day.

The second tier would involve the regular weekly inspection of sports grounds by the relevant LGA with the specific purpose of inspecting the ground surface and surrounds for its suitability for play and then the linking of this by action to the maintenance program in place for that sports ground.

The good practice recommendations provided in the report are derived from clear parameters by which sports ground surfaces should be evaluated. It is recognised that these parameters have largely been established for elite sport on major sports grounds using objective measures. In developing recommendations for grounds assessment best practice, the report has drawn on the currently available information and gives some guidance to sports officials and sports ground managers.

The recommendations for good practice have been adapted from a broad risk management approach to sport safety because it is important that grounds assessment becomes a part of the standard responsibilities of all LGAs and SSAs and their clubs. Chapter Nine of the full report provides further advice on the suggested components of a good practice approach to ground assessment practices.

Based on currently available information a suggested proforma and some guidelines for a good practice match day and training session checklist and good practice sports ground inspection checklists are provided in Appendices Five and Six of the report (and are reproduced and provided as an insert to this summary publication).

Complete report recommendations

The report recommendations are replicated below. It should be noted that each of the recommendations is referenced in the full report to the relevant chapter from where it arose and where the rationale for its need is established by the University of Ballarat researchers.

General Recommendations for Ground Assessment and Safety

- Consideration should be given by ground managers in Victoria, to promoting the use of rye grass in their grass mix and for reducing the amount of thatch on grasses on all fields.
- Strategies for changing the grass profiles on playing fields are more likely to be successful, in the long run, than requiring players to proactively change their boots in relation to the season stage.
- Match day checklists used to identify hazards to safe participation should be used by all clubs prior to both games and training. Records should be kept of all inspections along with a record of remedial action undertaken.

Recommendations



- Match day checklist should be standardised to cover major known hazards related to padding of fixtures, uneven surfaces, holes and debris, sprinkler covers and associated depressions, boundary to perimeter fencing, first aid facilities and emergency access.
- A two-staged approach to sports ground safety and suitability assessment is likely to be best practice. The first stage would involve pre game and training examination of the sports ground for hazards using a checklist. The second stage would involve the use of a validated Derived Score Method (DSM) type measure, with validated correlates of objective measures.
- An educational campaign should be developed (involving bodies such as Sport and Recreation Victoria, Regional Sporting Assemblies or the Victorian Smartplay Program) aimed at highlighting injury prevention as a direct outcome of ground safety policies and sports ground audits for safety and playing surface quality.
- Within each LGA and SSA/club, it should be clearly understood who is responsible for the identification and remediation of any identified hazard. A timeline for the implementation of hazard identification and remedial actions, and their communication to the next levels of the sport needs to be established.
- LGAs and regional/district sports associations should obtain a Clegg Hammer and survey each venue at least four times per football season. Hardness readings exceeding 120 gravities need attention.
- LGAs and regional/district sports associations should consider obtaining a Studded Boot Apparatus to survey each venue at least four times per football season. Traction readings exceeding 65 NM need attention.
- Given the influential role of the insurance industry, SSAs should work closely with their insurers to develop and refine suitable match day checklists for their sports.
- Each SSA and their associate clubs should clearly identify and name a person responsible for removing or controlling any hazards identified by the checklists. Guidelines for a timeline of implementation of responses should be developed by the SSA.

Recommendations for State Sports Association (SSA)/ Club Practice

- Broad based risk management approaches to assessing ground conditions adopted by LGAs, SSAs and their clubs should include consideration of general player safety measures, such as boundary placement and padding, and assessments of ground surfaces before play and in the case of inclement weather.
- Best practice exemplars highlighting co-operation between sporting clubs and LGAs in establishing and maintaining sports ground inspection should be developed in partnership and promoted through the sector. This should include a two-way feedback process on all ground assessments and suitability decisions.

- All SSAs should require a central lodging of all match day checklists, with an associated review process established.
- SSAs should work with their insurers to link the match day checklists with injury data, to demonstrate that their risk management approaches are reducing injuries and to promptly identify emerging injury issues.
- LGAs could consider employing contractors or consultants to assess shear traction on their fields to assess the strength of their turf.
- Soil moisture content is an important ground condition and LGAs should employ experienced consultants to assess this on a regular basis.

Recommendations for Local Government Authority (LGA) Policies and Practices

- Broad based risk management approaches to assessing ground conditions adopted by LGAs, SSAs and their clubs should include consideration of general player safety measures, such as boundary placement and padding, and assessments of ground surfaces before play and in the case of inclement weather.
- Within each LGA and SSA/club, it should be clearly understood who is responsible for the identification and remediation of any identified hazard. A timeline for the implementation of hazard identification and remedial actions, and their communication to the next levels of the sport, needs to be established.
- LGAs and regional/district sports associations should obtain a Clegg Hammer and survey each venue at least four times per football season. Hardness readings exceeding 120 gravities need attention.
- LGAs and regional/district sports associations should consider obtaining a Studded Boot Apparatus to survey each venue at least four times per football season. Traction readings exceeding 65 NM need attention.
- Grass type and coverage needs to be assessed by an agronomist or horticulturist. It is recommended that LGAs employ such experts to assess their grounds, including for advice at resowing.
- The Derived Score method used by some LGAs is a potentially useful approach and its checklists can identify important factors and hazards. As the scoring systems and weights are not yet validated, caution should be used when using these for decision-making.
- Should LGAs need to prioritise their ground assessment practices, the ordering of attention should be (in decreasing order) to assessing hardness, grip, botanical composition and then moisture content/thatch/shear strength.
- All LGAs should have a policy and an implementation plan for evaluating sports ground suitability. It is disconcerting that almost half of all LGAs do not currently have such policies and guidelines.
- The Municipal Association of Victoria, through its insurer Civic Mutual Plus should act as the 'driver' to ensure the involvement of all LGAs, particularly those in regional and rural areas, in sports ground suitability policy and implementation strategy development.

Recommendations



- It is recognised from a resourcing point of view, that it may not be possible for LGAs to give equal amounts of maintenance and regular assessment to all grounds. However, a consistent set of minimal standards for all ground maintenance of all grounds, irrespective of their grading, needs to be developed by LGAs and their insurers and adopted as regular ongoing practice.
- All LGAs should consider incorporating some objective measures in their assessments of grounds safety.
- Best practice exemplars highlighting co-operation between sporting clubs and LGAs in establishing and maintaining sports ground inspection should be developed in partnership and promoted through the sector.
- The likely reason for the higher hardness along the centreline is that of soil compaction under traffic. To overcome this, more regular decompaction of the centreline in comparison to the flanks is required. This needs to be done by contractors or LGAs, with the appropriate equipment, twice a year – once before the start of the cricket season and once before the start of the football season.

- Prospectively collected ground condition assessments need to be made on sporting grounds during the appropriate playing seasons for other sports (such as cricket and hockey) and clearly linked to injury data.
- Basic scientific work is needed to develop and test models for the causal pathways and mechanisms by which ground conditions and the early-season bias potentially influence injury risk.
- A comparative study of representative ground conditions, and their relationship to injury risk, needs to be conducted across all levels of play to determine the extent to which findings in elite, professional and semi-professional players can be directly translated to community or junior sport.

Recommendations for Improving the Evidence-Base for Ground Assessment Practices

- Biomechanical studies need to be undertaken to assess the extent to which, if at all, the measurements obtained from standard ground condition equipment relate to the actual forces and loads experienced by players during sporting activity. Both laboratory-based and field-testing is required.
- Most of the ground condition measures are applied independently and it is not known exactly how they relate to each other or to injury risk. A prospective study of injuries, over at least two seasons, is required to correlate the various ground conditions to each other and injury risk.

Recommendations for Improving the Evidence Base Linking Ground Conditions to Injury Risk

- Prospective studies, including ongoing injury surveillance and objective ground condition measurements need to be conducted over at least two full playing seasons in all codes of football and across all levels of play.

Recommendations



- Refinements to the Studded Boot Apparatus are needed, if it is to be used to measure injury risk, particularly with regards to different stud configurations and non-uniform ground interactions. Such refinements need to be correlated with injury and other ground condition measures.
- The scoring and weighting system used in the Derived Score Methods need further development and validation against both more objective ground condition measures and injury risk in players.
- Given that the monitoring of football fields occurred within a very dry year, it is pleasing that most of the measures are within the AFL limits. However, a proportion of readings were outside the limits. Further research is needed to determine if these results are repeated in more typical years and if the AFL limits can be reasonably adopted for use at community level.
- Normative ground conditions, related to injury risk need to be developed for non-elite football and for other sports. This needs to involve well designed prospective cohort studies of sports participants, their playing habits, associated injuries and objectively measured ground conditions at the same place at the same time, over at least two playing seasons.
- In order to provide normative data, representative of the range of climatic conditions in Victoria, further ground condition assessments should be made and collated on the grounds used in the trial, or similar grounds, over at least another one or two seasons.
- Ground hardness measures need to be made on multiple sites across a venue, particularly along the centreline, with supplemental measures on the flanks. When measuring grip or shear strength, it should be possible to make accurate assessments with just 5 randomly selected test points across a venue.
- It is possible that a relationship between moisture content and hardness could provide a possible indirect measure of surface hardness, through the means of monitoring the soil moisture. This requires further research.
- Further investigation into the relationships between aboveground factors and grip is needed. This would inform the development of a method for predicting grip on the basis of aboveground factors, if more data is obtained over a series of seasons.
- Methods for calculating more accurate water deficiency (potential) measures need to be developed. This should include consideration of the optimal timing and frequency of soil moisture assessment.
- Current field sampling plans across a venue for ground condition assessment are based on the main distribution of play during Australian Rules football (i.e. the centreline and flanks). Optimal sampling plans also need to be determined for the assessment of grounds for activities such as cricket and hockey, to mirror the areas of most use in these sports.

Recommendations



- Before recommendations for its widespread use can be made, the DSM requires further formal validation against objective ground condition measures across a variety of grounds, sporting activities and times of the season.
- To be fully validated, the DSM would also need to be compared directly with injury incidence data across a range of sports, over at least 2 playing seasons.

Further Investigations

This project sits within SRV's Risk Management and Injury Prevention Policy Framework aimed at ensuring injury does not preclude Victorians enjoying the benefits of participation in sport and active recreation.

As part of this framework, SRV has funded the School of Human Movement and Sport Sciences at University of Ballarat to undertake further work on ground condition assessment practices and injury risk. The planned study will validate the ground assessment practices for Australian Rules football.

The study will be linked to a significant National Health and Medical Research Council (NHMRC) funded investigation involving a large scale study of injuries to community level, adult, Australian football players, with a particular emphasis on lower limb injury prevention.

The NHMRC study is a randomized controlled trial to determine if particular training exercises can reduce the risk of such injuries. This large scale study is being conducted in both Victoria and Western Australia.

The adjunct study funded by SRV involves working with the Victorian component of the NHMRC funded investigation to provide scientific evidence describing the relationship between direct ground condition measurements, observational ground conditions, and injury in community level football.

As an outcome from this new study recommendations will be provided to community Australian Rules football about appropriate ground conditions for minimising injury risk in this sport. The study will also validate, and provide a final template for, a sport grounds assessment tool potentially based on the Derived Score Method checklists and guidelines.

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