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Ensuring Natural Grass Sports Fields Are Safe for Athlete Participation

A Risk-Assessment Process for Assessing Field Conditions Before Sports Activity

Lauren A. Petrass

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Caroline F. Finch

Abstract

Public safety is critical to the provision of sports fields and is dependent on maintaining natural grass surfaces and checking the safety of sports environments before play, to identify, remove and control hazards to reduce injury risk to participants. This paper presents and evaluates a Good Practice Sports Ground Inspection Form (GPSGIF), a new checklist developed to assist sports organizations, policy makers and field managers in the identification of injury hazards on natural grass fields. Use of the GPSGIF led to a consensus decision about the safety of grounds in >80% of assessments, and most items showed high levels of agreement. Comparisons of trained and untrained users showed that untrained assessors had higher levels of agreement, as they tended to rate grounds unsafe, suggesting they erred on the side of caution. The GPSGIF can be used by those responsible for sports field management to make consistent and evidence-informed decisions about field quality. Such assessments will provide athletes with the opportunity to compete in their chosen sport with minimized risk of injury. To enable a more thorough link between field conditions and injury, we would recommend that researchers' use the GPSGIF in future subjective ground assessment work.

Keywords: *safety assessment, safety checklist, injury risk, field conditions, sports injury, ground conditions*

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Introduction

Sports injuries are an important public health issue (Conn, Annett, & Gilchrist, 2003; Finch & Cassell, 2006), and both actual injury and the fear of injury are barriers to participation in sport and physical activity (Boufous & Finch, 2004). However, findings from controlled studies demonstrate that sports injuries are preventable (Parkkari, Kujala, & Kannus, 2001), and governing bodies of sport have an ethical and legal responsibility to prevent injuries by identifying, assessing, and controlling risks associated with their sport (Fuller & Drawer, 2004). The contribution of environmental hazards to injury risk in the sports injury setting has been previously recognized (Meeuwisse, Tyreman, Hagel, & Emery, 2007; Timpka, Ekstrand, & Svanström, 2006), particularly in relation to the safety of the playing fields (natural grass or artificial turf) on which sport is undertaken (Otago, Swan, Donaldson, Payne, & Finch, 2009; Swan, Otago, Finch, & Payne, 2009). Subjective measures, such as observational checklists, are frequently used by sports organizations, policy makers, and playing field managers to make evidence-informed decisions about playing field quality because they do not require heavy or expensive equipment (Chalmers, Samaranayaka, Gulliver, & McNoe, 2012; Ekstrand & Gillquist, 1983; Gabbett, Minbashian, & Finch, 2007; McMahon, Nolan, Bennett, & Carlin, 1993; Ramirez, Schaffer, Shen, Kashani, & Kraus, 2006; Twomey, Petrass, Orchard, & Finch, 2014). Further, there is a perception that these measures can be undertaken by anyone with limited skills, and it is assumed that the use of subjective checklists is sufficient to determine whether a playing field should be closed to protect athletes and officials from unsafe conditions.

A major limitation associated with the subjective assessments of natural grass fields to date, is the diverse and ill-defined terms used (e.g., muddy, hard, soft, wet, and dry), which makes it challenging to draw direct comparisons between studies. In addition, the robustness of the subjective assessments is unclear as, in many instances, inadequate detail has been provided about how the assessments were conducted, the number of locations observed on the field for the overall assessments, and whether the assessors had specific experience or training in the identification of field characteristics (Petrass & Twomey, 2013). Further, there are a number of additional risk factors, such as the amount of grass cover and surface evenness, which are not currently well assessed in the playing field assessment work (Canaway & Baker, 1993; Orchard, 2002). The two main surface characteristics that are likely to relate to injury risk on natural grass surfaces are ground hardness/shock absorbency (i.e., the effect that the surface has on absorbing impact energy) and traction (i.e., the type of footing or 'grip' a playing surface provides) (Orchard, 2002). With the exception of four studies (Andresen, Hoffman, & Barton, 1989; Chomiak, Junge, Peterson, & Dvorak, 2000; Gabbett et al., 2007; Lee & Garraway, 2000) that have included 'slippery' as a classification, subjectively-assessed studies of playing fields have predominantly assessed ground hardness. No published studies have previously subjectively assessed surface evenness (i.e.,

tripping hazards including undulations, cracks, holes etc.) or grass cover (i.e., the percentage of grass cover, grass condition or vigour, and grass height). Notwithstanding these limitations, the use of subjective, observational assessments has become widespread across many sporting codes (Chalmers et al., 2012; Ekstrand & Gillquist, 1983; Gabbett et al., 2007; McMahon et al., 1993; Ramirez et al., 2006) particularly for fields used for community sport. However, the knowledge gaps identified above limit the provision of clear guidance to safety professionals whose task it is to assess the safety of sporting fields.

In the real-world implementation context of community sport, with its resourcing and infrastructure limitations, it is likely that most playing field safety assessments will be undertaken using subjective means, such as visual observations recorded on a checklist. It is not always financially possible for local clubs or councils to purchase either the equipment that is needed to more objectively assess field conditions, or to pay for the services of trained field engineers who would regularly undertake this for them. Thus, to improve the quality of these subjective field assessments, and to ensure that they are able to identify hazardous conditions readily, there is a need for a comprehensive checklist that encompasses all playing surface components. Such a checklist must first be shown to have acceptable reliability and validity and specific guidance and/or training needs to be provided to ensure that intended users can use the checklist easily.

The aim of the present study was to (a) develop a comprehensive subjective field assessment checklist, the Good Practice Sports Ground Inspection Form (GPSGIF), that could be used to assess the safety of natural grass playing fields; (b) establish its face and content validity and inter-rater reliability; and (c) develop and evaluate a training package to accompany its role out to community sport organisations.

Material and Methods

The project was undertaken in Victoria, Australia, in response to the concerns of sports field facility managers, sports bodies, and community sports clubs in relation to the impact of prolonged drought conditions on sporting fields. This study was conducted within a risk management framework appropriate to the sporting context (Donaldson, Borys, & Finch, 2013; Fuller & Drawer, 2004). In particular, the checklist development was aimed at providing a new tool for the risk assessment phase necessary to first identify and assess potential hazards in the physical environments in which field-based sports are conducted.

In developing the checklist, a systematic approach was taken to ensure establishment of its validity and reliability, consistent with the principles of instrument development for survey research (Turocy, 2002). Initially, the sport injury risk literature was reviewed, and risk factors relating to hazardous ground conditions, including grass cover, surface evenness, ground hardness/shock absorbency and traction (Canaway & Baker, 1993; Orchard, 2002) were identified. The Match

Day Checklists commonly used by Victorian sports governing bodies (Swan et al., 2009) were reviewed and found to assess playing surfaces in very general terms only through a last minute check for hazards and a reminder regarding padding, perimeter distances and the like. Nonetheless, these items were used as a starting point for the physical hazards section of the new GPSGIF. The five key components identified in this initial phase including surface evenness (as it relates to player stability), grass cover (as it relates to evenness and traction), shock absorbercy (as it relates to hardness), grip (as it relates to traction and slipperiness), and other known hazards (similar to match day checklists) were used to delineate the main components of the checklist. In accordance with instrument development procedures (Turocy, 2002), the key components were used as a guide to inform where specific items or questions were best positioned on the checklist. For example, prior to this study, some local councils in Victoria had been using a non-validated checklist, the Derived Score Model (Otago et al., 2007). This measure considered grassed areas for vigour, height, cover, and evenness. Worn, bare areas and wicket areas were also evaluated, as was the presence of other surface hazards such as holes, cracks, hardness and damage by vehicles. These individual items were therefore assigned to the most appropriate component of the new checklist.

It was assumed that the GPSGIF would primarily be used to assess community level natural grass playing fields, and in these circumstances, a club nominee, often with little or no experience or prior knowledge in the identification of field characteristics would be expected to complete the subjective assessment. For this reason, a forced-choice response checklist designed for completion following thorough direct visual observation of a natural grass playing field was deemed most appropriate. In line with instrument development guidelines, questions were logically sequenced and neutral, non-leading language used (Turocy, 2002). Short but comprehensive guidance notes on observing, assessing and making a decision on each component were also developed and provided with the checklist (Smartplay, 2014). The checklist was also kept relatively short to avoid the likelihood of the task becoming onerous. The full version of the GPSGIF has been published and made available to the public through the Australian National Smartplay Program (Smartplay, 2014).

Making the validity process more systematic, including careful selection of a sample of experts enhances the quality of the validity measure (Trochim, Donnelly, & Arora, 2015). In order to confirm face and content validity, the draft GPSGIF was therefore provided to researchers who had previous experience in the assessment of playing field conditions. Their feedback on the content and focus of the draft GPSGIF was addressed in a revised version, which was also sent to them for final checking. At that stage, no further edits were deemed necessary.

To establish the reliability of the GPSGIF, 2-3 independent assessors completed the observational safety checklist on nine different community level Australian football fields (all natural grass) during an Australian football season. All assessors had previous experience in objective field assessments and were provided

with the guidance notes for the GPSGIF. Prior to completing the checklist, each assessor walked around the playing field individually, following the recommended pathway (Otago et al., 2007). After observing the field, assessors were required to complete all five components of the GPSGIF. Each assessor completed the checklist independently and no cross checking was undertaken on any occasion.

For the purposes of the initial reliability assessment, all assessments were considered independent, as the focus was on the level of agreement at each assessment. The percent of agreement across assessors was computed and a consensus rating decision was determined from the most common responses. A consensus decision was not reached when at least two of the individual ratings were different. When one of the decisions was “unsure” the consensus decision was based solely on the other one or two ratings, as appropriate, to replicate what would be done in practice. As research has suggested that respondents may select “unsure” or “neutral” categories because it requires less work than considering the alternatives (Krosnick, 1999), consistent with other studies (Granberg & Westerberg, 1999; McClendon & Alwin, 1993), reliability scores were calculated both including and omitting the “unsure” category.

An educational training package was developed to accompany the revised (final) GPSGIF. This was designed with the goal of enabling persons conducting inspections of playing fields using the GPSGIF to effectively identify and assess risks associated with sports injuries and playing surfaces. The training program delivery involved direct instruction and discussion with a trainer and a number of participants over a 1.5-hour session. The training program resources included the GPSGIF, a PowerPoint presentation for the trainer to use, and notes for the education session leader (trainer). The specific educational program learning outcomes were to enable participants to: (a) identify and assess the surface conditions of playing fields for safety, (b) recognize the need (or otherwise) to seek objective testing of a sports surface, (c) recommend sports field maintenance as required, and (d) demonstrate the capacity to make an overall judgement on whether the sports field is fit for play.

Six people, who had not been involved in the earlier trialling of the GPSGIF, were recruited to assess the value of the training package. They were randomly allocated to two groups, of three raters each, of which one group underwent formal training through the educational program and the remainder did not. Following the training, each of the six raters independently assessed the safety of four natural grass football fields on the same day using the final GPSGIF. The level of agreement between the trained and untrained raters was compared for all GPSGIF components.

Results

The level of final ground safety consensus ratings varied across components of the GPSGIF (Table 1). Perfect agreement was obtained for the hazards com-

ponent, but fewer than half of the grip assessments had full agreement amongst raters when the “unsure” ratings were included. When the “unsure” ratings were removed from the analysis, the level of agreement across all ratings increased to excellent or very high, with the exception of the grip component, which remained relatively low.

Table 1

The Extent of Consensus and Percentage Agreement Values Across Multiple Independent Ratings for the Components of the GPSGIF with Unsure Ratings Included and Excluded, Respectively

Component of the GPSGIF	Percent of assessments for which a consensus could be reached ($n = 31$)	Percent of assessments with full agreement amongst decisions (including the “unsure ratings”)	Percent of assessments with full agreement amongst decisions (excluding the “unsure ratings”)
Surface evenness	90	77	100
Grass coverage	97	68	81
Shock absorbency	87	61	81
Grip	77	48	65
Hazards	100	100	100

Comparison of the level of agreement for trained assessors versus untrained assessors demonstrated that with the exception of the hazards component, untrained assessors had higher levels of overall agreement on all components of the GPSGIF (Table 2). However, untrained assessors tended to rate the ground as potentially unsafe more often than did the trained assessors, as is evident from the low levels of consensus decisions between trained and untrained and low level of agreement when both trained and untrained assessors rated the ground as potentially unsafe (Table 2).

Table 2

Summary of the Extent of Agreement Across Ratings for Components of the GPSGIF for Trained vs. Untrained Assessors

Component of the GPSGIF	Number of assessments (out of a total of 12) with full decision agreements		Number of assessments (out of a total of 12) where the consensus decision was “potentially unsafe”	
	3 Trained assessors	3 Untrained assessors	3 Trained assessors	3 Untrained assessors
Surface evenness	6	9	7	9
Grass coverage	8	11	1	12
Shock absorbency	5	8	6	7
Grip	8	11	10	11
Hazards	9	6	0	2

Discussion

Due to current climatic conditions, the potential for hard, dry fields to negatively impact on sport safety has received a considerable amount of attention in the literature, and has been speculated as one of the primary reasons for ground closures based on increased injury risk (Twomey, Finch, Lloyd, Elliott, & Doyle, 2012). Injuries due to hard, dry fields have been postulated to occur through two mechanisms: (a) game speeds are faster on hard grounds that increase the collision impact forces when players collide with the ground or other players (Norton, Schwerdt, & Lange, 2001), and (b) harder surfaces invoke greater ground reaction forces, potentially increasing injury risk as the body has to absorb this force (Yates, 2012). While ground conditions including traction and hardness have been linked to injury, the methods used to assess playing field conditions vary (Grimmer, Jones, & Williams, 2000; McMahon et al., 1993; Orchard, 2001, 2002; Orchard, Chivers, Aldous, Bennell, & Seward, 2005; Twomey et al., 2012). Generally, fields have been subjectively assessed based on reporting against provided categorical descriptors, or on a subjective checklist prepared by insurance companies. However, these checklists largely only consider the identification of known hazards, and only contain one general statement relating to the surface of the playing field. This limits the value of the existing checklists for assessing field safety in relation to potential injury risk. The Australian sports industry, including sports bodies and local councils, has identified the need for an easy-to-use and accurate checklist to help them make better and more informed decisions about playing field conditions (Otago et al., 2009; Swan et al., 2009). This study has addressed this industry-driven need by developing and validating a comprehensive checklist, the GPSGIF, which considers all risk factors relating to playing field conditions and

injury risk reported in the literature, such as shock absorbency, grass cover, surface evenness, and traction/grip. The study also considered future implementation needs and developed an accompanying educational program to support the wide scale rollout of the GPSGIF.

Of all of the field condition components, raters found it hardest to make subjective assessments of grip as shown by the initial low levels of consensus and percentage agreement. The variability in grip safety ratings given by the initial three assessors across fields with varying conditions demonstrates the difficulty they experienced in subjectively assessing this factor across a ground. A possible explanation for this is that the field is only one element of the player-surface interaction (Petrass & Twomey, 2013) and the foot is the major interface with the field. In assessing grip, it is possible that the type of footwear worn by the rater could have played a key role in their final assessment by providing them with some tactile feedback about the field condition that they may have incorporated into their assessment. While the education program emphasized that any subjective playing field assessment should be conducted in the footwear that will be worn by players, this is difficult to control. Players change their footwear in response to the conditions, and Orchard (2002) noted that conditions are passively changed by the weather, but can also be manipulated with interventions such as grass height and watering as weather changes. Despite the difficulties with assessing grip, as traction has been identified as one of the main surface characteristics that may relate to injury (Orchard, 2002; Orchard, Seward, McGivern, & Hood, 1999), inclusion of this item in any subjective ground assessment checklist is critical. Based on the current findings, further emphasis on this component may be required in the education program. Alternatively, investigations into whether on-site training on sports fields with variability in grip enhances the accuracy of this component are warranted.

The GPSGIF can be used to reach a consensus agreement on the safety rating in 87% and 90% of shock absorbency and surface evenness assessments, respectively; however, these components only had full agreement for 81% of assessments. This could be due to the challenges associated with subjectively assessing these components across an entire playing field, particularly when there was variation between the cricket wicket areas and the surrounds. Alternatively, for the surface evenness component, the 'evenness' term may have been interpreted incorrectly and/or differently by the assessors, or the questions within this component may have influenced the result. For example, the presence of holes, worn areas and sprinklers that might cause a player to trip, or fall is primarily related to the "other hazards" component of the checklist. While undulations were provided as an example, further improvements to reliability are likely to be achieved if the hazard examples were removed and undulations were the sole focus of this statement. Because of this, both the final GPSGIF and the training program emphasized that surface evenness should only be assessed in terms of problematic variation or undulations that could lead to increased injury risk.

Comparison of assessments from the trained and untrained assessors on each of the five components of the GPSGIF indicated that, with the exception of the hazards component, untrained assessors had higher levels of overall agreement. While these results were not expected, it is evident that the educational program provided valuable information about the type of things that might be physical hazards associated with injury risk on sports fields, as trained assessors were more likely to agree than those who were untrained. For all other components of the GPSGIF, untrained assessors tended to rate fields as potentially unsafe more often than did the trained assessors, possibly as the untrained assessors might have assumed or felt obligated to report the field as unsafe, perceiving that was the desired response. This finding suggests that without training, or where the outcome of the assessment did not have implications for play, assessors may be conservative in their ratings. From a practical, implementation point of view this could be problematic because it is possible that untrained assessors would make decisions that are more likely to lead to facility managers/sports clubs stopping play or closing fields because it is perceived to be unsafe, when it could actually be safe. It is recommended however, that this training evaluation study is replicated with a larger sample. It would also be valuable to compare trained assessors' subjective ground assessments ratings with objective ground assessment measures to determine validity.

Conclusion

Subjective assessment of ground conditions are frequently used across sporting codes to make evidence-informed safety decisions about ground quality, specifically in relation to playing field use and closure. Subjective assessment to date, however, has focused primarily on field hardness, and assessments have lacked quality. Thus, there was an industry need to develop a checklist that comprehensively and consistently measured all relevant ground condition characteristics. Although injuries that are linked to ground conditions may never be completely eliminated, systematically assessing natural grass playing fields to identify, remove and/or control hazards will provide athletes with the opportunity to compete with minimized risk of injury.

Our findings suggest that the GPSGIF can be used to reach a consensus decision about the safety of fields in more than 80% of assessments and most items, excluding the assessment of grip, showed at least moderate agreement. While the reliability and validity of the current checklist was tested on Australian football fields, given the characteristics of this instrument, the checklist could be used to assess the ground conditions for other sports that are played on natural grass fields with little need for modification. Further work is now required to refine and validate the GPSGIF against objective ground measures to determine the level of agreement between subjective and objective assessments. However, to improve the consistency and quality of subjective playing field assessments and to enable

a more thorough link between field conditions and injury, we would recommend the use of the GPSGIF in future work that is limited to subjective assessment of natural grass playing fields.

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