



Review

Can the natural turf pitch be viewed as a risk factor for injury within Association Football?



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ABSTRACT

Objectives: A review of the current literature is used to propose a 'conceptual model for relative pitch hardness' and how this may affect incidence of injury within Association Football. Based upon the injury risk and causation model of Meeuwisse et al. (Clin J Sport Med 2007; 17(3):215), it may provide researchers a necessary framework to guide future research investigations.

Design: A literature review.

Methods: A comprehensive search of electronic databases available until October 2014, and supplemental hand searching was conducted to identify relevant studies. Studies were deemed relevant if they met the following criteria: published in English, presented or referenced in an epidemiological study or provided data directly and/or related to the surface of the football pitch, ball or boot to surface interaction and injury. Further information was sourced on surface hardness, players' movement patterns and physiological demands within football.

Results: Papers varied in methodological quality, with comparative studies examining injury rates on artificial versus natural turf pitches being most prevalent. No prospective studies were found that objectively measured the relationship between hardness of natural turf and injury risk within football.

Conclusions: The literature review into natural turf pitches and injury within football has largely been unable to confirm that pitch hardness can be viewed as a significant extrinsic risk factor. Methodological concerns, including objectivity in pitch assessment and uniformity in defining injuries undermine the efficacy of available work. Future studies are needed utilising objective assessment tools to draw more definitive conclusions regarding pitch hardness as an extrinsic factor for injury within football.

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1. Introduction

For the elite football player, injury rates are high with reported values in training between 1.5 and 7.6 injuries in each 1000 h exposure. This value increases in matches to 12–35 injuries per 1000 h.^{1,2} Researchers have attempted to attribute causality to injuries, proposing numerous risk factors that may influence injury occurrence. Consequently, relative injury risk is often broken down into intrinsic risks within the players, such as age, gender and previous injury, or extrinsic factors such as the pitch, opponents' actions, footwear or poor rehabilitation.^{3–6} Intrinsic risk factors only become relevant once the player is exposed to the extrinsic

environment of either training or matches. Thus, exposure to the external environment initiates a cyclical balance between susceptibility and adaptation, which if unstable may lead to injury. The complexity of such risk factors necessitates a multi-variant approach when examining the contribution of any factor(s) to injury.⁷

This article will consider one extrinsic factor to which all players are exposed, namely the pitch on which the game is played. Historically, grass pitches have been the playing surface in football for both training and matches. Quality standards have been published for the management of natural turf football pitches within England to enhance pitch safety and performance.^{8–11} Despite recognition that the natural turf pitch can be a factor for injury^{12–16} there has been little in the way of scientific evaluation of its risk value to the players.

This paper will (1) establish the current level of evidence, (2) discuss methodological concerns associated with research into pitch

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hardness, and (3) propose a ‘conceptual model’ of pitch hardness and injury risk within football which could provide a framework to guide future research.

2. Methodology: Approach to the development of the literature review

Literature was examined using Web of Knowledge, Scopus, MEDLINE, SportsDiscuss, ProQuest Direct Med, Cochrane library, CINAHL, Scirus and Google scholar. Databases were searched using the following terms: Soccer/football injuries, natural turf, grass and inj*, shoe interface and sports surfaces. Due to limited search findings with specific relevance to soccer, supporting evidence from other team sports was included to provide a better understanding of pitches and their effect on injury risk. References were deemed relevant if they met the following criteria: published in English, presented or referenced in an epidemiological study or provided data directly and/or related to the surface of the pitch, ball or boot to surface interaction and injury. In an attempt to add more global understanding to how the surface hardness may affect players’ movement patterns and physiological demands (issues that may be related to injury occurrence), further information was sourced on the effects of surfaces on energy expenditure, leg stiffness and running gait.

3. Current evidence that natural turf pitches affect injury incidence within Association Football

An extensive review across all football codes, reports that links between ground conditions and injury were mostly intuitive. From the available research papers ($N=79$) only five studies objectively measured pitches with none reporting strong associations between pitch hardness and an increased risk of injury.¹⁷ The majority of studies have instead adopted subjective means of pitch assessment, were poorly standardised and lacking sufficient definition. This makes it difficult to draw firm conclusions regarding the relationship between pitch hardness and injury.¹⁸

The paucity of research specifically related to Association Football is apparent as three studies were reported within this sport.¹⁷ All of the available data used subjective assessments of pitch conditions reporting associations of 24%^{19,20} and 21%²¹ between pitches and injury. It is unclear whether subjective measures provide a true reflection of pitch hardness and linking them to injury is difficult. Twomey et al.¹⁸ showed only 50–60% concordance between subjective and objective assessment of pitch hardness. The failure to denote a more comprehensive relationship between these approaches makes it questionable if subjective assessment is sufficiently robust to establish links between injury and pitch hardness. This is therefore a major limitation in the available data sets.

Within football objective measures of pitch hardness derived from devices such as the Clegg hammer^{8–11} have been reported but no studies have linked the values to the incidence of injuries. Other sports have used equipment such as the Clegg hammer,^{18,22,23} or the Penetrometer^{22,24–26} to gain objective measurements of hardness though a lack of consistency with respect to the equipment and protocols used impacts on transferability and applicability.²² Consequently, the available research may not have (a) effectively determined a true representation of the pitch hardness or (b) evaluated how this variable may directly influence the risk of injury. On the whole then there seems to be little available research that effectively directly investigates the impact of pitch surface on injury. This would seem to be an important omission for both our theoretical understanding of injury mechanisms and practical approaches to injury prevention.

Indirect evidence that pitch hardness may adversely affect injury has been drawn from research that (a) compares injury incidence between artificial and natural turf pitches; (b) proposes a seasonal bias for injuries; or (c) critically interprets how the pitch may impact factors that can lead to injury such as biomechanical load, speed of the game and player movement.

Pitch hardness: Injury incidence on artificial versus natural turf: The majority of research in football relating pitches to injury focuses on comparative studies outlining the incidence of injury on artificial or natural grass surfaces.^{12–16} First Generation artificial turf pitches in the 1970’s with their short nylon fibres were reported as being hard.²⁷ This made the playing characteristics different from natural grass pitches with many studies reporting a significant increase in the incidence of injuries, particularly abrasions and sprains.^{12–15} The artificial pitches of today are more representative of their grass counterparts with longer fibres and rubber granular infill promoting more acceptable levels of hardness.¹⁶ Such are the improvements in artificial surfaces that many studies report no significant differences in injury incidence between them and the natural turf pitch.^{16,27,28} Nevertheless, evidence remains indicating persistent differences between injuries sustained on the two different surfaces.^{29–33}

None of these studies reported what characteristics of the playing surface were directly attributable for the injury rates witnessed, nor did they objectively scrutinise the pitches. This suggests an inherent assumption amongst some researchers that pitches remain constant over time. This however is not the case as even artificial pitches demonstrate large degrees of temporal and spatial variation.³⁴ Natural turf pitches are living things and will exhibit greater temporal and spatial variation than their artificial counterparts. Research using ‘natural turf’ as an undefined variable in injury studies may mask the variation within and among such surfaces. This observation could be highly significant in investigations of this nature.³⁵

Seasonal bias, pitch hardness and injuries: In England, one of the largest epidemiological studies in football reported evidence for an early season bias for injury. The study reported peaks in training injuries in July while match injuries seemed to be at their highest in August.³⁶ Surface dryness (hardness) over the pre-season period was associated with 70% of injuries a value which fell to 51% during the season. Wet or muddy pitches were recorded in 40% of all in season injuries whereas they were only noted in 8% of those injuries sustained in pre-season. These findings were supported by the results from the UEFA Champions League study which prospectively tracked injury data from 27 top clubs, across ten European countries between 2001 and 2012.³⁷ This longitudinal approach corroborating the findings of Hawkins³⁶ highlights the apparent robustness of an increase in injury during the early season period when pitches are frequently reported as being harder.^{38,39}

Such relationships are also noted in the Australian Football League (AFL) where the prevailing climatic conditions in the northern territories of Australia lead to drier, harder, pitches. These conditions were associated with a 2.8 fold increase in rates of Anterior Cruciate Ligament (ACL) injuries than the softer wetter pitches of the southern regions.²⁶ Variable climatic conditions were also highlighted in the Champions League study⁴⁰ where geographically regionalised injury differences were reported. This may suggest that the prevailing climatic conditions of varied countries and therefore their pitch conditions (hard or soft) may influence the injury rates recorded. However, unlike the AFL study,²⁶ the Champions League study⁴⁰ did not evaluate the pitch conditions at time of injury.

Some caution must be exercised when attempting to make causal attributions regarding seasonal bias for injury and pitch hardness. Reduced early seasonal fitness levels, changes in footwear and the high exposure to training loads over the

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