Catastrophic Injuries in Rugby Union: An Assessment of the Risk

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EXECUTIVE SUMMARY

Fatalities and spinal cord injuries are high consequence, low incidence injuries that occur in collision team sports and individual sports, such as horse riding and gymnastics. It is incumbent on all stakeholders from governing bodies to individual athletes to manage the risks associated with these injuries through the introduction of appropriate risk mitigation strategies, such as the laws of the game, protective equipment or education and training programmes. The normal method for demonstrating that risks are managed effectively is through the process of risk assessment, which is an element within the broader framework of risk management. No activity is risk free and the process of risk management is not intended to reduce levels of risk to zero; however, it is generally regarded that in most aspects of life, there are some levels of risk that are acceptable and others that are unacceptable. In this context, the Health and Safety Executive in the UK has defined norms for what can be regarded as negligible, acceptable, tolerable and unacceptable levels of risk. An acceptable level of risk generally relates to the risk of a serious adverse consequence, such as a fatality or a spinal cord injury resulting in permanent neurological deficit, occurring on average between 0.1 and 2 times/100,000 people per year. The aims of this project were to assess the level of risk associated with catastrophic injuries in rugby union, to reach a conclusion about whether the level of risk is acceptable and to review current guidance on coaching and refereeing.

The scientific literature was reviewed in order to collect data on catastrophic injuries (defined here as fatalities and spinal cord injuries) sustained during rugby union activities in England (1956-2002) and other countries (1970-2005). In addition, equivalent data were collated for catastrophic injuries sustained in a range of other sports and non-sports activities. The probability of sustaining a catastrophic injury in rugby union (number of events/100,000 exposed population per year) was compared with the probability associated with these other activities and with the Health and Safety Executive’s guidelines on negligible, acceptable, tolerable and unacceptable levels of risk.

The results indicated that for rugby union players in England, the risk of sustaining a catastrophic injury (0.84/100,000 per year) came within the Health and Safety Executive’s ‘acceptable region’ of risk (0.1 to 2/100,000 per year), whilst the average risk of catastrophic injury experienced by rugby players in other countries (4.6/100,000 per year) fell within the ‘tolerable region’ of risk (2 to 100/100,000 per year). The risk of sustaining a catastrophic injury in rugby union in England was generally lower than that experienced in a wide range of other collision sports, such as ice hockey (4/100,000 per year), rugby league (2/100,000 per year) and American Football (1/100,000 per year). The risk of catastrophic injury in rugby union was comparable with that experienced by most people in UK work-related situations (0.8/100,000 per year) but less than that experienced by motorcyclists (190/100,000 per year), pedestrians (3.7/100,000 per year) and car occupants (2.9/100,000 per year).

The results presented here indicate that the laws of the game and the guidance provided by the RFU adequately manage the risk of catastrophic injury in rugby union in England. However, the Rugby Football Union should not be complacent, as there does not appear to be a coherent, multi-disciplinary, game-wide strategy aimed at players, coaches and referees for managing the risk of catastrophic injuries. In addition, epidemiological data about these injuries in England depends on a voluntary reporting system by clubs and schools with little information collected about the specific nature or the causes of the injuries or the total population of rugby players exposed to the risks of injury. Without this type of information it is difficult to evaluate the effectiveness of intervention strategies for reducing the incidence of catastrophic injuries. The RFU’s Catastrophic Injury Task Group has recognised many of the existing procedural weaknesses and made recommendations to the RFU Management Board about how these issues could be addressed. The positive initiatives related to the management of catastrophic injuries that have been made by the RFU Medical and Coaching Groups should be supported and further developed by the RFU Management Board.
1.0 INTRODUCTION

The risk of injury in many sports is high and therefore all stakeholders from sports governing bodies to individual athletes have a responsibility to manage these risks and, where possible, reduce the level of risk. Both UKSport (Fuller, 2004) and the Australian Sports Injury Prevention Taskforce (Department of Health and Ageing, 2003) advocate the application of risk management principles for managing the risks associated with sport.

1.1 RISK MANAGEMENT IN SPORT

The key stages of the risk management process are outlined in the framework presented in Figure 1 (Fuller 2007). The first stage identifies the initiating roles of intrinsic (athlete dependent) and extrinsic (event/situation dependent) risk factors: the relationships that exist between these risk factors and injury are developed in more detail in the injury causation models developed by Meeuwisse et al. (1994, 2007). The second stage provides an estimate of the risks by measuring the incidence and severity of injuries through epidemiological studies whilst the third stage evaluates whether mitigation measures are required to reduce the risk to socially acceptable levels. Stages two and three are encapsulated in the four-step injury prevention model proposed by van Mechelen et al. (1992), which consists of a cycle of ‘epidemiology – aetiology – prevention – epidemiology’. Stage four of the framework identifies the important but under-developed process of communicating information about the levels of risk to stakeholders within a sport and explaining the measures available to control or reduce these risks. Whilst the risk framework incorporates the ideas contained within Meeuwisse’s risk factors and van Mechelen’s injury prevention models, it also takes account of wider issues, such as athletes’ perceptions of risk, individual and societal concerns about risk and the role of communication in educating athletes about the risks of injury in sport.

Figure 1: Risk management framework (Fuller, 2007)
1.1.1 Risk estimation
Injury risk, which can be defined as the expected loss in a particular situation within a stated period of time, is quantified using the product of the average consequence of all adverse events (injury severity) and the probability that these adverse events will occur within a specified time period (incidence of injury):

\[
\text{Risk} = \text{Severity} \times \text{Incidence} = \left( \frac{\text{Expected total loss}}{\text{Unit time}} \right) \times \left( \frac{\text{No. of events}}{\text{Unit time}} \right) .... (1)
\]

In addition, the incidence of injury can be defined by how often events with the potential to cause injury occur (frequency) and the proportion of these events that translate into adverse outcomes (propensity for injury):

\[
\text{Incidence} = \text{Frequency} \times \text{Propensity} = \left( \frac{\text{No. of loss events}}{\text{Unit time}} \right) \times \left( \frac{\text{No. of loss events}}{\text{No. of events}} \right) .... (2)
\]

In the context of catastrophic injury, the loss (severity) from an adverse event can be, for example, the short-term cost of post-injury treatment, the medium-term cost of rehabilitation and/or the long-term cost of healthcare for the injured athlete. Because costs vary from country to country, an athlete’s time-loss from sport is the most common measure used to describe injury severity.

1.1.2 Risk factors
Equation (1) can refer to the average risk associated with a defined sample population in a specific setting or to the individual risk experienced by a single athlete within the overall sample population (Fuller, 2007). Individual risk is different from population risk because the risk experienced by individual athletes is affected by their own intrinsic risk factors and by the way in which these personal factors interact with the athlete’s specific role within the sport. In the context of catastrophic injury, the individual risk of a front row forward sustaining a catastrophic injury is different from that of a scrum half. Each athlete, therefore, has a unique risk value and the distribution of risk for the whole population is described by the variation in the individual risk values of all the athletes within the total population.

1.1.3 Risk acceptance
No activity is risk free and the process of risk management is not intended to reduce levels of risk to zero. Individual and societal levels of acceptable risk are normally context dependent and are affected by a complex interaction of individual beliefs, attitudes and personalities (Fuller and Vassie, 2004). In most aspects of life, there are some levels of risk that are generally considered to be acceptable and others that are considered to be unacceptable. In occupational settings, levels of acceptable risk are often embedded within national health and safety legislation, whereas, in sport, the levels are normally defined by the laws and regulations framed by the sports’ governing bodies. Each sport’s governing body should instigate an on-going review process to ensure that the current laws and regulations for their sport remain appropriate to the risks and to the concerns of stakeholders. This requires an injury surveillance system that can monitor and evaluate trends and changes in risks with time.

1.2 CATASTROPHIC INJURIES
There is no universally accepted definition of a catastrophic injury; in the context of this report, it refers to fatalities and brain/spinal cord injuries that result in significant permanent neurological deficits: this definition is consistent with the one adopted by the RFU Catastrophic Injury Task Group (CITG). Most fatalities in sport arise through non-sport-related cardiovascular problems in athletes. Although sport-related fatalities do occur their occurrence is extremely rare and injuries to
the spinal cord represent the largest group of catastrophic injuries. The spine, especially the thoracic region of the spine, is a common site of injury in sport and non-sport activities. Most injuries to the thoracic region result from poor posture and are not life threatening or incapacitating. For example, this type of injury is responsible for a large proportion of time-loss injuries in industry (HSE, 2006). The overall incidence of acute spinal cord injury was estimated to be between 1.5 and 4 cases/100,000 population per year in the USA, with prevalence between 72 and 91 per 100,000 (Sekhon and Fehling, 2001). Although the incidence of catastrophic spinal injuries is much lower, acute trauma to the cervical region of the spine is a major cause of permanent disability. The clinical aspects and mechanisms of cervical spine injuries are outside the scope of this report and are not discussed here, as these issues have been adequately discussed previously in several publications (Torg et al., 1990; Winkelstein and Meyers, 1997; Silver, 2002; Quarrrie et al., 2002; Toth et al., 2005; Barile et al., 2007). Motor vehicle accidents are probably the most common cause of catastrophic spinal injury, accounting for 43% of cases in Australia and 45% in the USA (O’Connor and Brown, 2006). It has been estimated, however, that between 5 and 10% of all cervical spine/spinal cord injuries in the USA (Korres et al., 2006), 16% in the UK (Savage, 1995) and 15% in Australia (Carmody et al., 2005) are sport-related.

Severe cervical spine injuries occur in a wide range of contact (e.g. American football, Australian Rules Football, rugby league, ice hockey and rugby union) and non-contact (e.g. snowboarding, gymnastics horse riding and diving) sports with equestrian events reported to be the most likely to lead to catastrophic injury (Ball et al., 2007). It was claimed that there was a two-fold increase in the incidence of catastrophic spinal injuries in rugby union during the 1970s and early 1980s (Rotem et al., 1998) and, despite changes to the laws of the game to address this issue, there was no sustained reduction in the incidence during the 1980s (Noakes and Jakoet, 1995; Armour et al., 1997). Forwards are consistently reported to be the most likely players to sustain a catastrophic spinal injury (Armour et al., 1997: 83%; Secin et al., 1999: 78%; Spinecare Foundation, 2003: 73%). The scrum was identified as the most likely phase of play (62%) to cause a catastrophic spinal injury in Australia in the period 1960-1985, whereas in the period 1986-1996, the ruck/maul (42%) was reported to be the most likely (Spinecare Foundation, 2003). On the other hand, Noakes et al. (1999) in South Africa (52%) and Shelly et al. (2006) in Ireland (67%) identified the tackle as the phase of play most likely to lead to a catastrophic spinal injury.

1.3 AIMS AND OBJECTIVES
The aim of this project was to assess the level of risk associated with catastrophic injuries in rugby union, to reach a conclusion on whether the level of risk is acceptable by comparison with the levels of risk associated with other sport and non-sport activities and to review current RFU guidance for reporting, coaching and refereeing in the context of catastrophic spinal injuries. Specific project objectives were to:

- determine the incidence of catastrophic injuries in rugby union in England and compare this with reported values from other countries;
- compare the level of risk of catastrophic injuries in rugby union with other sports;
- compare the level of risk of catastrophic injuries in rugby union with non-sport activities;
- compare the risk of catastrophic injuries in rugby union with the norms defined by the Health and Safety Executive; and
- review the RFU’s current procedures for reporting catastrophic injuries and guidance provided for coaches, referees and players in respect of catastrophic injuries.
1.4 REPORT STRUCTURE
Following this introduction, Section 2 of the report considers background information related to the management of risk. Section 3 details the methodology adopted for collecting and analysing data on catastrophic injuries in sport and other activities. Section 4 presents the results on catastrophic injuries obtained from the literature for sport and other activities. Section 5 discusses the findings and, finally, Section 6 presents the conclusions from the study.
2.0 BACKGROUND INFORMATION

This section of the report considers briefly the important underpinning elements of the risk management process.

2.1 RISK AND RISK MANAGEMENT
Risk is the chance of a particular situation or event having an adverse impact on an individual’s, organisation’s or society’s objectives within a stated period of time. Risk is normally measured in terms of its consequences and the probability of these consequences occurring: risk is therefore a measure of future outcomes. Risk management is the systematic application of management policies, procedures and practices for identifying, analysing, evaluating, controlling and monitoring risks. Implementing risk management strategies implicitly indicates that decisions have been made to accept certain known levels of risk with or without the application of risk control measures; this in turn implies that a formal or informal cost benefit analysis has been undertaken as part of the overall management process.

2.2 RISK MANAGEMENT AND PEOPLE
There is a dilemma when dealing with risk because individuals view and react to the same risks in different ways. Some people try to reduce their exposure to risk (risk-averse behaviour) whilst others look to increase their exposure (risk-taking behaviour). Individuals can often control their exposure to events by, for example, not taking part in a particular activity, whereas a controlling organisation, such as a sport’s governing body, has the potential to change the magnitude of the consequences and the probability that adverse consequences arise from the events by changing the laws of the game. People who make decisions about risk or who determine what level of risk is acceptable/unacceptable in an environment are responsible for managing the risks experienced by individuals and society in that particular environment. The public expects governing bodies to be responsible for protecting people from unacceptable risks over which they, as individuals, have little or no control. People are generally satisfied about levels of risk if they feel they can control their level of exposure to a risk by their own voluntary actions. However, if exposure is involuntary and unfavourable consequences occur, people will, at some point, turn to the issue of compensation and identify the person or organisation who they believe to be responsible for managing the risk.

Current views about the legal liability for a wide range of risks within sport have been summarised by James (2006). The law of negligence is the same in a sports environment as it is in any other context. To prove negligence by an athlete it is necessary to demonstrate a failure to show a duty of care by one participant to another participant. This duty is defined as the need to exercise a level of care that is reasonable for the avoidance of injury in the prevailing circumstances. The prevailing circumstances in a sporting event include the sport’s objectives, the normal demands made on participants, the hazards associated with the sport, the laws/rules applicable to the sport, the normal conventions/customs and the level of performance that one may reasonably expect from a participant (James, 2006). The requirement for a duty of care is not restricted to the athletes: for example, a referee and the national sports governing body were held liable for a rugby player’s injury when a referee failed to control the scrums in a rugby match (Vowles v Evans and Welsh Rugby Union [2003] EWCA 318, [2003] 1 WLR 1607) and a national sports governing body was held liable for a failure to provide adequate medical support during a boxing match (Watson v British Boxing Board of Control [2001] QB1134).
2.2.1 Risk assessment

It is incumbent on responsible bodies to demonstrate that risks have been managed in a responsible and acceptable manner. The normal process for demonstrating that this responsibility has been discharged is through the process of risk assessment.

Risk assessment procedures can provide qualitative or quantified values of risk: quantified values are obtained using theoretical calculations and/or peoples’ experiences of past failures. Quantified values of risk impart a degree of accuracy and precision to an assessment and assist in the development of risk control strategies. Measures of risk are by definition subject to uncertainty; therefore, however reliable the statistical data may be, it is not possible to predict the exact outcome in a risk situation because, if it were possible, there would be no risk attached to the activity as the outcome would be known. It should be remembered that quantified values of risk are normally based on historical data of events and/or consequences of risk situations: hence values are based on populations that have previously been exposed to the risk and these results may not reflect the future risk of an individual within a different population or in a different environment. Although statistical uncertainty is associated with any quantified measure of risk, these uncertainties should be viewed against the alternative of using stakeholders’ guesses, beliefs and prejudices. If this latter approach were used in the process of risk management, it would be almost impossible to reach any valid conclusions about the acceptability of risk for any issue. There are, therefore, clear benefits to be gained from collecting statistical data and using quantified risk assessment procedures. When completing a risk assessment, it is important to identify clearly which stakeholders are at risk because identifiable groups of people, such as rugby players, would be subject to different levels of risk than a statistical person in the general population, who most probably would not play rugby.

2.2.3 Risk perception

Although risk is defined by statistical parameters such as probability, problems of understanding and interpreting these values are often not related to the values themselves but to the way in which individual people interpret their significance. Variation in interpretation is an issue of perception rather than a result of errors in the evaluation of the risk per se. Although most people accept that the potential outcomes of exposure to situations and events can be quantified objectively in terms of, for example, the incidence of death, injury, ill health and/or financial losses, evaluation of these risks is less easily defined, as risks can be split into ‘objective’ (statistical) and ‘subjective’ (perceived) components (Slovic, 1992). This situation exists because risk evaluation involves human judgements about the acceptability of risk, either directly or indirectly, and these judgements are inevitably based on subjective criteria (Royal Society, 1992).

The ways in which individuals and organisations perceive risk are important because these perceptions affect decisions and actions about risk at the national as well as the individual level. Risk perception, unfortunately, is not an absolute measure; it is a personal view of risk and, as such, everyone can claim that his or her perception of a risk is as valid as another person’s. Most measures and commentaries on risk perception involve comparative views of risk, which means making a personal judgement about whether one risk is perceived to be more or less acceptable than another risk; this aspect of risk management creates a major problem because one person’s greatest fear is not necessarily the same as another person’s. For example one person may fear heights whilst another person may be happy to sky dive from the top of the tallest building. In addition, certain aspects of risk have been reported to have a negative effect on people’s perceptions of risks; the two aspects having the greatest impact are referred to as the dread/non-dread and the known/unknown factors. Characteristics associated with these factors are shown in Table 1.
Table 1: Characteristics associated with the 'Dread/Non-dread' and 'Known/Unknown' risk perception factors (Slovic, 1992)

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Characteristics associated with Risk Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dread / Non-dread</td>
<td>Feared / not feared</td>
</tr>
<tr>
<td></td>
<td>Uncontrollable / controllable</td>
</tr>
<tr>
<td></td>
<td>Global consequences / non-global consequences</td>
</tr>
<tr>
<td></td>
<td>Fatal consequences / non-fatal consequences</td>
</tr>
<tr>
<td></td>
<td>Risks not equitably distributed / risks equitably distributed</td>
</tr>
<tr>
<td></td>
<td>Catastrophic consequences / non-catastrophic consequences</td>
</tr>
<tr>
<td></td>
<td>High risk to future generations / low risk to future generations</td>
</tr>
<tr>
<td></td>
<td>Not easily mitigated / easily reduced</td>
</tr>
<tr>
<td></td>
<td>Risk level increasing / risk level decreasing</td>
</tr>
<tr>
<td></td>
<td>Involuntary exposure to risk / voluntary exposure to risk</td>
</tr>
<tr>
<td>Known / Unknown</td>
<td>Observable risk / non-observable risk</td>
</tr>
<tr>
<td></td>
<td>Risk known to those exposed / risk unknown to those exposed</td>
</tr>
<tr>
<td></td>
<td>Immediate consequences / delayed consequences</td>
</tr>
<tr>
<td></td>
<td>Risk known to science / risk unknown to science</td>
</tr>
</tbody>
</table>

Appreciating the relevance of these characteristics is important for developing an understanding of stakeholder views about risks such as catastrophic injury in sport. Fischhoff et al. (1978) studied how people viewed a wide range of risks using this framework and their results are summarised simply in Figure 2.

Figure 2: The Known/unknown and Dread/non-dread dimensions of risk perception

Issues that falls into the region defined by unknown/dread characteristics will relate to risks where the public has significant concerns and for which there will be calls for government intervention to
control the risks. On the other hand, issues that fall into the region defined by known/non-dread characteristics will relate to risks where the public has few concerns and for which there are more likely to be campaigns for non-intervention.

Law (2007) discussed an important paradox associated with activities where adverse incidents have become increasingly rare. In this situation, the public (and media) become less tolerant of these rare adverse events and there is a tendency to over regulate the risks due to an irrational perception of the residual level of risk. In these cases, reporting systems are often introduced to record ‘near misses’ because there are so few actual adverse events.

Individuals’ views on risk are also influenced by factors such as familiarity and self-interest and this can lead to either an understatement or an overstatement of the risks; this issue is referred to as affiliation bias. In most situations, there are official bodies, such as the International Rugby Board (2007a), that regulate risks and establish appropriate standards and procedures for controlling the risks in specific environments. Unfortunately, society as a whole often does not trust the conclusions and proposals made by these ‘independent’ bodies, as they are perceived to have self-interests. This often leads to conflict between stakeholders and regulatory bodies. People’s perceptions of risk also change over time and with circumstances; hence, risks that were once perceived to be acceptable may later be perceived to be unacceptable and vice versa. In addition, even the most impartial and critically appraised risk assessments may not be accepted by stakeholders because evaluations of risk inevitably involve a level of subjectivity and, if the stakeholders at risk do not have the same values as the people undertaking the assessment, the outcome of the risk assessment will be questioned.

2.2.2 Acceptable levels of risk

The risk assessment process provides an estimate of the level of risk that exists in a particular situation for a particular person or group of people within a particular environment: the assessment does not however define whether the level of risk is acceptable either to the individual or to society. Acceptable levels of risk are defined by people’s perceptions of the risks and the norms within society. Most people, however, would agree with the general statement that there were three broad levels of risk:

(i) risks that are so high that they are clearly unacceptable for every member of society;
(ii) risks that are so low that they can be regarded as negligible for every member of society; and
(iii) risks that fall between these two levels.

Ideally, most people would prefer to live in a world where there is negligible risk; this would be considered as a state of existence where one would never need to consider the probability or consequences of adverse events. However, there is always risk in life because merely being alive carries with it a multitude of natural and man-made risks of death. In reality everyone dies at some point in time, it is merely a matter of when and how. Within both social and occupational environments, it is important therefore to agree on what should be regarded as an acceptable level of risk or, failing that, a tolerable level of risk.

There are many problems associated with defining acceptable and tolerable levels of risk. The Health and Safety Executive (HSE, 1988) defined the region of tolerable risk to an employee as a probability between 1 in 5x10⁴ and 1 in 10³ per year that a fatality would occur and the region of acceptable risk as a probability between 1 in 10⁶ and 1 in 5x10⁴ per year that a fatality would occur. In the UK, the HSE (1995) provided guidelines for defining levels of work-based risk that are described as negligible, acceptable, tolerable and unacceptable:
• A **negligible level of risk** is ‘a level of risk, usually presumed to be below 1 in one million per annum and perhaps much lower, of seriously adverse consequences occurring, where no thought is given to their likelihood in the conduct of normal life’.

• An **acceptable level of risk** is ‘a risk in the region of 1 in one million of a serious adverse occurrence, where the conduct of life is not affected provided that we are in fact satisfied that reasonable precautions are in place’.

• A **tolerable level of risk** is ‘a range of risk that we do not regard as negligible or as something we might ignore, but rather as something we need to keep under review and reduce it still further if and as we can’.

• An **unacceptable level of risk** is ‘a risk which is beyond (above) the region of tolerability’.

A serious adverse occurrence is normally taken to mean a fatality but, in the context of this study, it is taken to be a catastrophic injury, which encompasses fatalities and brain/spinal cord injuries resulting in significant permanent neurological deficit.

### 2.3 RISK HOMEOSTASIS AND RISK COMPENSATION

Risk homeostasis is based on a *constant-risk hypothesis* (Wilde, 1982; Fuller, 1986), which postulates that individuals always work towards a defined level of risk, irrespective of the measures put in place to reduce the levels of risk. In broad terms, individuals define their own overall acceptable level or **target level** of risk. This target level of risk will be influenced by where an individual’s personality/behaviour sits within the risk-averse to risk-taking spectrum and will be based on an individual’s assessment of the personal benefits and costs, of which money is only one of many utility factors. Individuals compare their target levels of risk with the risk levels associated with each of the options available to them to achieve their desired level of risk. Their decisions are moderated by their perceptions of the risks involved.

The risk compensation model presented by Adams (1995) postulated that:

• everyone has a propensity to take risks within appropriate limits;
• the propensity to take risks varies from one individual to another and the level of risk will depend on their personality, needs and motivational requirements;
• the propensity to take risks is influenced by the potential level of the rewards and the losses arising from risk-taking behaviours;
• individual’s perceptions of risk are influenced by their own and other people’s experiences of accident losses;
• individual’s risk-taking decisions and behaviour represent a balancing act in which their perceptions of risk are balanced against their propensity to take risks;
• benefits and losses arise from an individual taking risks; and
• the more risks an individual takes the greater the potential level of benefits and costs.

The concepts of risk homeostasis and risk compensation are often used to explain why some people prefer high-risk sports, such as mountaineering and hang gliding, whilst others prefer low-risk sports, such as croquet and snooker.
3.0 METHOD

The main aim of the study was to determine the incidence of catastrophic injuries in rugby union and to compare the value with the incidence of similar injuries sustained in other sport and non-sport activities. This section of the report identifies methodological issues related to the collection of data on the incidence of catastrophic injuries in rugby union and other environments and to the review of RFU guidelines for reporting, coaching and refereeing in terms of catastrophic injuries.

3.1 REVIEW OF THE LITERATURE

The main themes, issues and sources of data related to catastrophic injuries in rugby union, other sports and other activities were reviewed using literature searches of the Embase, PubMed, Medline and SafetyLit databases. Searches were undertaken of the American Journal of Sports Medicine, British Journal of Sports Medicine, British Medical Journal, Clinical Journal of Sports Medicine, Clinics in Sports Medicine, Medical Journal of Australia, Medicine and Science in Sports and Exercise, Scandinavian Journal of Medicine and Science in Sport and Sports Medicine. In addition, the Cochrane Database of Systematic Reviews and the official web sites of the Australia, England, New Zealand and South Africa rugby unions were searched. The Health and Safety Executive web site was also searched for general articles on the management of risk and the incidence of fatal injuries.

RFU publications entitled ‘The A-Z of Community Rugby’ (RFU, 2007c), ‘Player’s Safety, Nos. 1 to 8’ (RFU, 1999), ‘Front Row in Union’ (RFU, 2001) and ‘Tackling Safety: Peak Performance and Injury Prevention’ (RFU, 2004) together with the accompanying DVD were reviewed. RFU web pages related to injury recording, prevention, treatment and rehabilitation; coaching; and refereeing were also reviewed. The content of some RFU web pages related to this report were changed after the preparation of the first draft of this report. This led to some discrepancies in the advice provided on the reporting of injuries on different RFU web pages; it is assumed that these discrepancies will be eliminated in due course.

The RFU CITG submitted their Final report to the RFU Management Board in April 2007: a copy was made available to the author of this Report after the first draft was submitted. The RFU CITG document has been reviewed and where appropriate comments have been incorporated into this Report.

3.2 DEFINITION OF CATASTROPHIC INJURY

No universally accepted definition of a catastrophic injury in the context of rugby union was identified in the literature; however, there was some consistency in many of the definitions used; for example:

(a). Cases of cervical spinal cord injuries resulting in admission to a hospital spinal unit with permanent neurological deficit such as tetraplegia (Rotem et al., 1998).
(b). Cases of permanent neurological deficit, such as paraplegia and quadriplegia (Shelly et al. (2006).
(c). Well-documented objective permanent neurological deficit (Spinecare Foundation, 2003).
(d). Injury that resulted in a brain or spinal cord injury or skull or spinal fracture (NCCSIR, 1999).
(e). Major trauma, such as admission to intensive care unit, urgent surgery (within 24 hours of admission to hospital) involving intra-cranial, intra-thoracic, intra-abdominal injury or fixation of spinal or pelvic fracture (Gabbe et al., 2005).
(f). The occurrence of an acute, traumatic lesion of neural elements in the spinal canal (spinal cord and cauda equina) resulting in temporary or permanent sensory deficit, motor deficit, or bladder/bowel dysfunction (Thurman, 1995).

(g). A brain or spinal cord injury that results in permanent (>12 months) severe functional disability (iRB consensus statement definition: Fuller et al., 2007).

For the purposes of this study, catastrophic injuries that complied with the definition presented in the iRB consensus statement (Fuller et al., 2007) were included in this review of data sources. Deaths from other causes, such as cardiovascular irregularities and heat stress, were not included in the data analysis, as these were not considered to be a direct consequence of the sport of rugby union itself.

3.3 INCIDENCE OF CATASTROPHIC INJURIES

The incidence of catastrophic injuries in rugby union, other sports and other activities are generally low and, therefore, there are very few prospective studies of injuries of this type reported in the literature. Most research related to catastrophic injuries has been undertaken and reported in the form of case report or case series retrospective studies with ill-defined populations at risk; these studies seldom report the incidence of injury. The two main exceptions to this generalisation are the data collected for catastrophic injuries sustained in a range of sports by high school and college students in the USA, which are reported annually by the National Center for Catastrophic Sport Injury Research (NCSSIR, 2007), and the data reported on fatalities at work in the UK reported annually by the Health and Safety Executive. In these studies, data are collected prospectively and incidences are reported as the numbers of fatalities and/or spinal cord injuries/100,000 people at risk per year.

In the present report, where incidence values were not specifically reported in a publication, the incidence was calculated using the numbers of injuries reported in the publication and the best estimate of the exposed population at risk available from other reports or publications. Where incidences of injury were calculated in this way, the source used for the number of injuries is provided together with the source of information used for the estimated population at risk.

Acceptable levels of risk are normally defined as the number of fatalities/100,000 population at risk per year and fatal accident rates are therefore reported in a similar way to enable the appropriate comparisons to be made. For this reason, incidences of catastrophic injuries are presented in this report in the same format.
4.0 RESULTS

A major problem in comparing the incidence of catastrophic injuries in rugby union and other sports is that the types of injury included in published reports vary significantly between publications. In many publications, non-permanent spinal injuries are reported alongside spinal injuries resulting in permanent disability. As this report is only concerned with spinal injuries that result in permanent disability, the data were, where possible, corrected so that they included only those spinal injuries that resulted in permanent functional deficit. However, it must be recognised that it was not always possible to identify these cases and the results presented here may therefore include less severe spinal injuries and hence the reported incidences of catastrophic injuries may be too high. For the purposes of this risk assessment, it was considered preferable to err on the side of inclusion rather than exclusion of cases when insufficient information was available in the original publication, so that the risk from catastrophic injury was not deliberately under-estimated.

4.1 INCIDENCE OF CATASTROPHIC INJURIES IN RUGBY UNION

The following sections report the incidence of catastrophic injuries in rugby union in England over the period 1956 to 2002 and in other countries in the Northern and Southern hemispheres over the period 1976 to 2002.

4.1.1 England

Most research publications related to catastrophic injuries in England report the number of cases in the form of case report/series studies; no publications reported the incidence of catastrophic injuries. The incidence values presented in Table 2 were, therefore, derived from the number of injuries reported in various publications and the estimated average number of club and school rugby union players in England over the period 1992 to 2002 (490,000) that was reported by the Rugby Football Union (2002) Governance Committee. The validity of this number was supported by the value of 400,000 players presented in a paper published by Secin et al. (1999), although the source of this value was not reported in the research paper. A personal communication from the RFU Community Rugby Medical Group (M England to CW Fuller, 5 July 2007) provided an estimate of the total rugby-playing population as 627,000, which was made up of 211,000 adult, 100,000 youth and 317,000 junior/midi players. It was not considered appropriate to include ‘mini’ players in the exposed population for this study, as these players are not subject to the same risk of injury from tackling and scrummaging as the other players. Assuming that half of the ‘junior/midi’ group of players were ‘mini’ players (159,000), the total rugby-playing population exposed to the risk of catastrophic injury would be 470,000 players, which is in close agreement with the value quoted above (490,000). A further personal communication from the RFU Community Rugby Medical Group (M England to CW Fuller, 6 July 2007) confirmed that there have been no reports of catastrophic injury sustained by ‘mini’ players, which supports the assumption made. Exclusion of the ‘mini’ group of players from the exposed population therefore ensures that the risk of catastrophic injury is not under-estimated. The incidence values presented for England in Table 2 are subject to four potential sources of error:

(i) It cannot be verified that the number of injuries reported in each of the studies related to the total population at risk, in which case the incidence of injuries reported may be an under-estimate of the true value.

(ii) The actual number of players in England cannot be verified. If the number of players reported is high, the incidence of injury will be an under-estimate of the true risk; on the other hand, if the number of players reported is low, the calculated incidence of injury will be an over-estimate of the true value.
(iii) Some of the data values were derived from the same data base of injuries; however, because each report refers to a different period of time, the results do provide a level of cross-validation.

(iv) Some of the reported values refer only to spinal injuries whilst other values refer to spinal and fatal injuries.

Table 2: Incidence of catastrophic injuries in England over the period 1956 to 2002 (injuries/100,000 participants per year).

<table>
<thead>
<tr>
<th>Time period</th>
<th>Type of injury</th>
<th>Incidence</th>
<th>Source of exposure data</th>
<th>Source of injury data</th>
</tr>
</thead>
<tbody>
<tr>
<td>1956 - 1982</td>
<td>Spinal</td>
<td>0.48</td>
<td>RFU, 2002</td>
<td>Silver, 1992</td>
</tr>
<tr>
<td>1976 - 1993</td>
<td>Spinal</td>
<td>0.70</td>
<td>RFU, 2002</td>
<td>Haylen, 2004</td>
</tr>
<tr>
<td>1982 - 1987</td>
<td>Spinal</td>
<td>0.73</td>
<td>RFU, 2002</td>
<td>Silver, 1992</td>
</tr>
<tr>
<td>1992 - 1997</td>
<td>Spinal + Fatal</td>
<td>0.82</td>
<td>RFU, 2002</td>
<td>RFU, 2002</td>
</tr>
<tr>
<td>1997 - 2002</td>
<td>Spinal + Fatal</td>
<td>0.78</td>
<td>RFU, 2002</td>
<td>RFU, 2002</td>
</tr>
<tr>
<td><strong>AVERAGE</strong></td>
<td></td>
<td><strong>0.84</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The average incidence value reported gives equal weight to each of the values included in Table 2.

4.1.2 Other countries

The incidence of catastrophic injuries reported for rugby union in other countries over the period 1976 to 2005 are presented in Table 3. These results are subject to the same qualifying remarks presented in section 4.1.1.

Table 3: Incidence of catastrophic injuries in a range of countries over the period 1976 to 2005 (injuries/100,000 participants per year).

<table>
<thead>
<tr>
<th>Country</th>
<th>Time period</th>
<th>Type of injury</th>
<th>Incidence</th>
<th>Source of exposure data</th>
<th>Source of injury data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentina</td>
<td>1977 - 1997</td>
<td>Spinal + Fatal</td>
<td>1.9</td>
<td>Secin, 1999</td>
<td>Secin, 1999</td>
</tr>
<tr>
<td></td>
<td>1984 - 1996</td>
<td>Spinal</td>
<td>7.0</td>
<td>Rotem et al., 1998</td>
<td>Rotem et al., 1998</td>
</tr>
<tr>
<td></td>
<td>1997 - 2002</td>
<td>Spinal</td>
<td>3.2</td>
<td>Carmody et al., 2005</td>
<td>Carmody et al., 2005</td>
</tr>
<tr>
<td></td>
<td><strong>Average for Australia</strong></td>
<td></td>
<td><strong>4.4</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fiji</td>
<td>1997</td>
<td>Spinal + Fatal</td>
<td>13</td>
<td>Maharaj et al., 1998</td>
<td>Maharaj et al., 1998</td>
</tr>
<tr>
<td>Ireland</td>
<td>1995 - 2004</td>
<td>Spinal</td>
<td>0.89</td>
<td>Shelly et al., 2006</td>
<td>Shelly et al., 2006</td>
</tr>
<tr>
<td>New Zealand</td>
<td>1976 - 1985</td>
<td>Spinal</td>
<td>5.0</td>
<td>Quarrie et al., 2002</td>
<td>Haylen, 2004</td>
</tr>
<tr>
<td></td>
<td>1986 - 2000</td>
<td>Spinal</td>
<td>7.4</td>
<td>Quarrie et al., 2002</td>
<td>Haylen, 2004</td>
</tr>
<tr>
<td></td>
<td>1984 - 1996</td>
<td>Spinal</td>
<td>2.3</td>
<td>Quarrie et al., 2002</td>
<td>Quarrie et al., 2002</td>
</tr>
<tr>
<td></td>
<td>1998 - 2005</td>
<td>Spinal</td>
<td>2.0</td>
<td>Quarrie et al., 2007</td>
<td>Quarrie et al., 2007</td>
</tr>
<tr>
<td></td>
<td><strong>Average for New Zealand</strong></td>
<td></td>
<td><strong>4.2</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>AVERAGE (all results)</strong></td>
<td></td>
<td></td>
<td><strong>4.4</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>AVERAGE (all countries)</strong></td>
<td></td>
<td></td>
<td><strong>4.6</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The average incidence values presented in Table 3 are based on (i) all the values included in the Table and (ii) the average values shown for each country.

Apart from the result presented for Ireland, the incidences of injury in these countries were between 3 and 15 times higher than those presented for England in Table 2. Although the average incidence value for these countries is five times higher than the value reported for England, it is not possible to comment on the statistical significance of this difference.

4.2 CAUSES OF CATASTROPHIC INJURIES IN RUGBY UNION

The causes of catastrophic injuries in rugby union over the period 1952 to 2005 are summarised in Table 4.

<table>
<thead>
<tr>
<th>Country</th>
<th>Time period</th>
<th>Phase of play in which injury occurred, %</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Tackle</td>
<td>Scrum</td>
</tr>
<tr>
<td></td>
<td>1997 - 2002</td>
<td>41</td>
<td>32</td>
</tr>
<tr>
<td>Canada</td>
<td>1975 - 1982</td>
<td>22</td>
<td>78</td>
</tr>
<tr>
<td>Ireland</td>
<td>1995 - 2004</td>
<td>63</td>
<td>13</td>
</tr>
<tr>
<td>New Zealand</td>
<td>1976 - 1995</td>
<td>33</td>
<td>45</td>
</tr>
<tr>
<td>South Africa</td>
<td>1963 - 1989</td>
<td>50</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>1985 - 89</td>
<td>50</td>
<td>40</td>
</tr>
<tr>
<td>UK</td>
<td>1956 - 1982</td>
<td>24</td>
<td>24</td>
</tr>
<tr>
<td>Wales</td>
<td>1966 - 1984</td>
<td>30</td>
<td>40</td>
</tr>
</tbody>
</table>

There are no clear trends in injury causation either with time or country. However, specific differences may be obscured through differences in definitions of catastrophic injury and in reporting procedures adopted for injury causation within individual studies.

4.3 INCIDENCE OF CATASTROPHIC INJURIES IN OTHER SPORTS

Catastrophic injuries occur in many sports other than rugby union. The following sections report the results from Australia and the USA for a range of sports.
4.3.1 Australia
Results are presented separately for contact and non-contact sports.

Contact sports
The incidences of catastrophic injuries reported in Australia for Australian Rules football, rugby league and football (soccer) are summarised in Table 5.

Table 5: Incidence of catastrophic injuries in a range of contact sports in Australia over the period 1984 to 2002 (injuries/100,000 participants per year).

<table>
<thead>
<tr>
<th>Sport</th>
<th>Country</th>
<th>Time period</th>
<th>Type of injury</th>
<th>Incidence</th>
<th>Source of injury data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rugby league</td>
<td>Australia</td>
<td>1984 - 1996</td>
<td>Spinal</td>
<td>1.8</td>
<td>Rotem et al., 1998</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1986 - 1996</td>
<td>Spinal</td>
<td>2.4</td>
<td>Carmody et al., 2005</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1997 - 2002</td>
<td>Spinal</td>
<td>1.5</td>
<td>Carmody et al., 2005</td>
</tr>
<tr>
<td>Australian Rules</td>
<td>Australia</td>
<td>1986 - 1996</td>
<td>Spinal</td>
<td>0.34</td>
<td>Spinecare, 2003</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1997 - 2002</td>
<td>Spinal</td>
<td>0.52</td>
<td>Carmody et al., 2005</td>
</tr>
<tr>
<td>Soccer</td>
<td>Australia</td>
<td>1986 - 1996</td>
<td>Spinal</td>
<td>0.03</td>
<td>Spinecare, 2003</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1997 - 2002</td>
<td>Spinal</td>
<td>0.19</td>
<td>Carmody et al., 2005</td>
</tr>
</tbody>
</table>

The results presented in Table 5 are based on the populations at risk defined in the individual publications and therefore the results are subject to fewer sources of error than those presented in section 4.1 for rugby union. In general, the incidences of catastrophic injuries reported for these sports were lower than those reported for rugby union in Australia (Table 3).

Non-contact sports
One study from Australia (Gabbe et al., 2005) reported the incidences of fatal and serious injuries for a range of sports (Table 6) but used a broader definition of serious injury, namely:

*Major trauma, such as admission to intensive care unit, urgent surgery (within 24 hours of admission to hospital) involving intra-cranial, intra-thoracic, intra-abdominal injury or fixation of spinal or pelvic fracture.*

Table 6: Incidence of fatal and serious injuries in a range of sports in Australia over the period 2001 to 2003 (injuries/100,000 participants per year).

<table>
<thead>
<tr>
<th>Sport</th>
<th>Incidence of injury*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horse riding</td>
<td>29.7</td>
</tr>
<tr>
<td>Motor sport</td>
<td>113.3</td>
</tr>
<tr>
<td>Rock climbing</td>
<td>6.6</td>
</tr>
<tr>
<td>Snow skiing</td>
<td>2.5</td>
</tr>
<tr>
<td>Swimming</td>
<td>1.8</td>
</tr>
<tr>
<td>Australian Rules Football</td>
<td>5.5</td>
</tr>
</tbody>
</table>

*: results based on data presented in Gabbe et al., 2005.
Although a contact sport, the incidence value for Australian Rules Football is included in this table in order to indicate the impact on the incidence value of using a broader definition of serious injury. The incidence of injury in Australian Rules Football was approximately an order of magnitude (x10) higher than the values of 0.34 and 0.52 obtained using the more stringent definition of catastrophic injury used in the collection of data presented in Table 5.

4.3.2 USA
The largest and most comprehensive system used for recording catastrophic injuries is the one implemented by the National Center for Catastrophic Sport Injury Research for High School and College students in the USA. Cantu and Mueller (1999) analysed this database, for the period 1982 to 1997, are summarised in Table 7.

Table 7: Incidence of catastrophic injuries in a range of sports in the USA over the period 1982 to 1997 (injuries/100,000 participants per year).

<table>
<thead>
<tr>
<th>Sport</th>
<th>Incidence of injury*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High School level</td>
</tr>
<tr>
<td>American Football</td>
<td>0.98</td>
</tr>
<tr>
<td>Baseball</td>
<td>0.28</td>
</tr>
<tr>
<td>Gymnastics</td>
<td>1.7</td>
</tr>
<tr>
<td>Ice hockey</td>
<td>1.7</td>
</tr>
<tr>
<td>Lacrosse</td>
<td>0.23</td>
</tr>
<tr>
<td>Soccer</td>
<td>0.12</td>
</tr>
<tr>
<td>Swimming</td>
<td>0.16</td>
</tr>
<tr>
<td>Track and Field</td>
<td>0.21</td>
</tr>
<tr>
<td>Wrestling</td>
<td>0.62</td>
</tr>
</tbody>
</table>


Apart from soccer, which had the lowest incidence of injury for both High School and College students, the incidence of injury was consistently higher for students competing at College level compared to High School level.

4.4 INCIDENCE OF WORK-RELATED FATAL INJURIES
Catastrophic injuries occur in most work activities. However, in reporting results most publications group catastrophic spinal injuries with other serious injuries and fatal injuries are reported separately. In the following sections, therefore, the results refer to the incidence of fatal injuries.

4.4.1 The UK
The best sources of data available for work-based fatalities are the annual UK ‘Statistics of Fatal Injuries’ produced by the Health and Safety Executive (2006). These data sources were used to prepare the summary of fatal injuries at work presented in Table 8.
Table 8: Average incidence of fatal injuries amongst employees in the UK by work sector over the period 1992 - 2006 (fatalities/100,000 workers per year).

<table>
<thead>
<tr>
<th>Work sector</th>
<th>Incidence of fatalities*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture, forestry, etc</td>
<td>6.0</td>
</tr>
<tr>
<td>Extractive, utility supply</td>
<td>4.9</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>1.3</td>
</tr>
<tr>
<td>Construction</td>
<td>6.0</td>
</tr>
<tr>
<td>Service sector</td>
<td>0.4</td>
</tr>
<tr>
<td><strong>ALL</strong></td>
<td><strong>0.9</strong></td>
</tr>
</tbody>
</table>

*: results based on data presented in HSE, 2006.

4.4.2 Other countries

Table 9: Comparison of work-related fatal injuries amongst employees in several countries (fatalities/100,000 workers per year).

<table>
<thead>
<tr>
<th>Work sector</th>
<th>Incidence of fatalities*</th>
</tr>
</thead>
<tbody>
<tr>
<td>United Kingdom</td>
<td>0.8</td>
</tr>
<tr>
<td>Sweden</td>
<td>1.4</td>
</tr>
<tr>
<td>Norway</td>
<td>1.6</td>
</tr>
<tr>
<td>Denmark</td>
<td>1.8</td>
</tr>
<tr>
<td>Switzerland</td>
<td>2.0</td>
</tr>
<tr>
<td>Finland</td>
<td>2.1</td>
</tr>
<tr>
<td>Australia</td>
<td>2.6</td>
</tr>
<tr>
<td>Germany</td>
<td>3.0</td>
</tr>
<tr>
<td>New Zealand</td>
<td>3.1</td>
</tr>
<tr>
<td>Belgium</td>
<td>3.3</td>
</tr>
<tr>
<td>United States</td>
<td>4.0</td>
</tr>
<tr>
<td>Ireland</td>
<td>4.2</td>
</tr>
<tr>
<td>Austria</td>
<td>4.5</td>
</tr>
<tr>
<td>France</td>
<td>4.5</td>
</tr>
<tr>
<td>Greece</td>
<td>6.2</td>
</tr>
<tr>
<td>Italy</td>
<td>7.0</td>
</tr>
<tr>
<td>Canada</td>
<td>7.1</td>
</tr>
<tr>
<td>Spain</td>
<td>7.9</td>
</tr>
<tr>
<td>Portugal</td>
<td>8.7</td>
</tr>
</tbody>
</table>


The incidences of work-related fatal injuries in countries outside the Established Market Economies group are generally very much higher than the values presented in Table 9.
4.5 **INCIDENCE OF TRAFFIC-RELATED FATAL INJURIES IN THE UK**

Although fatalities associated with road traffic accidents are very high in the UK compared with other activities, the UK has one of the best road safety records in Europe (National Statistics, 2007). The estimated incidence of fatalities for pedestrians, motor cyclists and car users in the UK for 2005 are presented in Table 10.

Table 10: Estimated incidence of road-related fatal injuries in the UK for 2005 (fatalities/100,000 population per year).

<table>
<thead>
<tr>
<th>Category</th>
<th>Number of fatalities</th>
<th>Estimated exposed population (Department of Transport, 2004)</th>
<th>Incidence of fatalities*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pedestrians</td>
<td>1,008</td>
<td>60,000,000</td>
<td>3.7</td>
</tr>
<tr>
<td>Motor cyclists</td>
<td>467</td>
<td>250,000</td>
<td>190</td>
</tr>
<tr>
<td>Car users</td>
<td>1,762</td>
<td>27,000,000</td>
<td>2.9</td>
</tr>
</tbody>
</table>


4.6 **INCIDENCE OF CATASTROPHIC INJURIES IN NON-SPORT ACTIVITIES IN AUSTRALIA**

Data are collected routinely in Australia about the causes of catastrophic injuries for the population as a whole. For the purposes of comparison in this report, data are presented separately for spinal cord and fatal injuries.

4.6.1 **Spinal cord injuries**

The incidence of traumatic spinal cord injuries within the over 15 year age group in Australia has remained fairly constant at around 1.5 cases/100,000 population/year, over the period 1986 to 2005 (Cripps, 2006; O’Connor, 2002). A detailed analysis of the causes of spinal cord injuries is presented in Table 11.

Table 11: Incidence and cause of spinal cord injuries in Australia for 2005 (fatalities/100,000 population per year).

<table>
<thead>
<tr>
<th>Cause of injury</th>
<th>Incidence of spinal cord injury*</th>
</tr>
</thead>
<tbody>
<tr>
<td>On-road – motor vehicle occupants</td>
<td>0.37</td>
</tr>
<tr>
<td>On-road – unprotected road users (motor cycles, pedal cycles and pedestrians)</td>
<td>0.23</td>
</tr>
<tr>
<td>Off-road – motor vehicle occupants</td>
<td>0.02</td>
</tr>
<tr>
<td>Off-road – unprotected road users (motor cycles, pedal cycles and pedestrians)</td>
<td>0.14</td>
</tr>
<tr>
<td>Falls</td>
<td>0.45</td>
</tr>
<tr>
<td>Hit by object</td>
<td>0.15</td>
</tr>
<tr>
<td>Diving and surfing</td>
<td>0.14</td>
</tr>
<tr>
<td>Other</td>
<td>0.04</td>
</tr>
<tr>
<td><strong>ALL</strong></td>
<td><strong>1.54</strong></td>
</tr>
</tbody>
</table>

*: results based on data presented in Cripps, 2006.

The results presented here probably under-estimate the risk of sustaining spinal cord injuries from off-road activities because the calculations assume that the whole population is exposed to this type of activity.
4.6.2 Fatalities

The incidences of fatal injuries are grouped into the sub-categories of ‘Unintentional’ and ‘Intentional’ causation. Results for the period 2003/04 (Henley et al., 2007) are presented in Table 12.

Table 12: Incidence and cause of fatal injuries in Australia for 2003/04 (fatalities/100,000 population per year).

<table>
<thead>
<tr>
<th>Cause of injury</th>
<th>Incidence of fatal injury*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Unintentional</strong></td>
<td></td>
</tr>
<tr>
<td>Transport</td>
<td>8.6</td>
</tr>
<tr>
<td>Falls</td>
<td>14.0</td>
</tr>
<tr>
<td>Drowning</td>
<td>1.3</td>
</tr>
<tr>
<td>Poisoning</td>
<td>5.6</td>
</tr>
<tr>
<td>Fire, smoke</td>
<td>0.7</td>
</tr>
<tr>
<td>Other</td>
<td>8.0</td>
</tr>
<tr>
<td><strong>Intentional</strong></td>
<td></td>
</tr>
<tr>
<td>Suicide</td>
<td>10.8</td>
</tr>
<tr>
<td>Homicide</td>
<td>1.1</td>
</tr>
<tr>
<td><strong>ALL</strong></td>
<td><strong>48.5</strong></td>
</tr>
</tbody>
</table>

*: results based on data presented in Henley et al., 2007.
+: the sum of the rows exceeds the total value because some deaths were ascribed to more than one cause of death

4.7 FATALITY RATES IN THE UK FOR MISCELLANEOUS ACTIVITIES

In order to provide a wider comparison of the level of risk of catastrophic injury in rugby union, a collection of miscellaneous fatal accident rates for the general population of the UK are presented in Table 13.

Table 13: Death rates for a range of miscellaneous activities in the UK (deaths/100,000 population at risk per year).

<table>
<thead>
<tr>
<th>Cause of fatalities</th>
<th>Incidence of death</th>
<th>Source of data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cancer (All)</td>
<td>258</td>
<td>HSE, 2001</td>
</tr>
<tr>
<td>Violence</td>
<td>40</td>
<td>HSE, 1988</td>
</tr>
<tr>
<td>Maternal death during pregnancy</td>
<td>12</td>
<td>HSE, 2001</td>
</tr>
<tr>
<td>Lightning</td>
<td>0.005</td>
<td>HSE, 2001</td>
</tr>
</tbody>
</table>

The high incidence of death resulting from cancers should be compared to the annual lifetime risk of death for everyone in the population of 1000/100,000 population per year.
5.0 DISCUSSION

In order to fully appreciate the ensuing discussion, it is necessary to understand the legal interpretation of ‘risk’ and the requirement for risks to be managed effectively. In the case Regina v Board of Trustees of the Science Museum in 1993, the Court of Appeal in England ruled that the word ‘risk’ should be interpreted as meaning ‘the possibility of danger’. For employers, such as professional rugby clubs, the management of work-related risks is also a legal requirement under the Management of Health and Safety at Work Regulations 1999: these Regulations state that: ‘Every employer shall make a suitable and sufficient assessment of the risks to the health and safety of his employees to which they are exposed whilst they are at work.’ The implications in civil and statute law are that any situation presenting a potential for danger should be properly managed. In the sport of rugby union, as with many other sports, there are situations where there is the possibility of danger and many of these situations have been identified in epidemiological studies of injuries. Although national and international governing bodies for the sport do not have an employer-employee relationship, their responsibility to manage these situations so that the level of risk to players is reduced to or maintained at an acceptable level has been established in law (Watson v British Boxing Board of Control [2001] QB1134; Vowles v Evans and Welsh Rugby Union [2003] EWCA 318, [2003] 1 WLR 1607).

5.1 RISK ASSESSMENT

There are many problems associated with defining the probability of catastrophic injury in sport and other activities. Many of these problems relate to the usual difficulties encountered in epidemiological studies, such as variations in injury definition and units of exposure (Brooks and Fuller, 2006). In addition, because catastrophic injuries are rare events, most reported data are derived from retrospective study designs and these are not as reliable as data obtained from prospective studies. Most research publications that have discussed the issue of catastrophic injuries in rugby union in England provided only the numbers of injuries and/or related them to an unspecified sample population, which made it difficult to calculate the incidence of injury accurately. In addition, because there are limited sources of information about catastrophic injuries, some data were analysed by the same or other author(s) on more than one occasion. In this report, apart from cases where the data presented in one publication were exactly the same as those presented in another publication, each set of data was included separately. In some cases, where the numbers of injuries were reported without exposure data, it was possible to use estimates of exposure obtained from other publications in order to calculate an incidence value. Whilst this approach does raise issues of accuracy and reliability, the study was more concerned with determining the best estimate of the magnitude of the risk rather than defining a precise value.

The difficulty of conducting a prospective cohort study to define the incidence of catastrophic injuries can be illustrated effectively by considering the study of spinal injuries in professional rugby union by Fuller et al. (2007). In this study, the authors followed first team squad players at Premiership rugby union clubs in England (around 400 players per season) over two seasons and reported that no catastrophic injuries were recorded. Despite the size of this study, it is only possible to conclude from the results that the incidence of catastrophic injuries was <125 injuries/100,000 players per year. In order to be able to report that the incidence of catastrophic injuries was <2 injuries/100,000 players per year, which is the upper limit of the ‘acceptable region’ of risk (HSE, 1988), it would be necessary to follow a cohort of 400 players for 125 seasons. Clearly this would be an impossible situation. Alternatively, a cohort of 200,000 players could be studied for 1 season; this amounts to an injury surveillance study of the whole rugby population in England.
5.2 RISK COMPARISON

Injury and ill-health are inevitable risks in all aspects of life so it is worth taking into account that the lifetime average annual risk of death in the UK is 1 in 100 people per year, which is based purely on a human life expectancy of 100 years. This equates to a total population risk of 1,000 deaths/100,000 population at risk per year. The annual risk of death for an individual, however, is not the same, as the risk of death generally increases with age. This level of risk however forms a baseline against which all other comparative risks should be judged. Although risk is defined by the incidence and severity of injuries (equation 1), many people find it difficult to interpret these values and to appreciate the possible equivalence of high incidence/low consequence and low incidence/high consequence risks. The discussion presented in this report relates to an assessment of the risk of catastrophic injury in rugby union, which is a high consequence/low incidence risk.

Most people find it easier to compare and rank risks against activities with which they are familiar (Fuller and Myerscough, 2001). The public generally considers risks to be acceptable if the perceived level of risk is no higher than that associated with normal everyday activities. One major advantage of using a risk ranking or comparative approach is that it increases the level of transparency in the overall management process. Many of the results presented in Section 4 of this report have been summarised in Figure 3 so that the relative risk of catastrophic injury in rugby union can be compared easily with the risks associated with other common sport and non-sport activities. The regions of negligible, acceptable, tolerable and unacceptable risks defined by the HSE (1988) have also been incorporated into Figure 3 for comparative purposes. The results indicate that for rugby union players in England, the risk of sustaining a catastrophic injury (0.84/100,000 per year) comes within the ‘acceptable region’ of risk (0.1 to 2/100,000 per year), whilst the average risk of catastrophic injury for rugby union experienced in all other countries (4.6/100,000 per year) falls within the ‘tolerable region’ of risk (2 to 100/100,000 per year). The risk of sustaining a catastrophic injury in rugby union in England is generally lower than that experienced in a wide range of other collision sports, such as ice hockey (4/100,000 per year), rugby league (2/100,000 per year), American Football (1/100,000 per year) and wrestling (0.8/100,000 per year). Of particular note, however, is the conclusion that rugby union carries a lower risk of sustaining a catastrophic injury than gymnastics (8.2/100,000 per year), which is a popular and acceptable sport for children. The risk of catastrophic injury from rugby union in England is comparable with that experienced by most of the population in work-related situations (average: 0.8/100,000 per year) but much less than that experienced by car occupants (2.9/100,000 per year), pedestrians (3.7/100,000 per year) and motorcyclists (190/100,000 per year). The risk of sustaining a catastrophic injury in rugby union is an order of magnitude lower than the risk of death experienced by women during pregnancy (12/100,000 per year).
Figure 3: Comparison of the incidence of death/fatal/catastrophic injury in various activities (deaths/injuries/100,000 participants per year)
Having compared the risk of sustaining a catastrophic injury in rugby union with the risks in other common activities, what conclusions can be drawn from the comparison and are the conclusions valid?

The UK Government uses the process of risk assessment widely in developing policy decisions and practices where the outcomes of events can be presented in probabilistic terms, such as adverse effects from food, medicine and consumer products (Interdepartmental Liaison Group on Risk Assessment, 1996, 1998). Whilst it is recognised that ranking risks provides an effective way of assessing the acceptability of risks, it is also recognised that representing risks by a single risk value can be misleading, as account must also be taken of the public’s perception of the risks and of the inherent differences in the types of risk that are being considered (Interdepartmental Liaison Group on Risk Assessment, 1998). Simple questions, such as whether a slow painful death from lung cancer can and should be treated as being equivalent to a sudden death in a road traffic accident, must still be resolved before definitive risk comparisons can be made. A definition proposed for an acceptable level of risk is ‘a level of risk that incorporates ambient risk as its benchmark, and such risk is no greater than those encountered in everyday life’ (Law, 2007).

Clearly, the comparative analysis presented in this report shows that the risk of sustaining a catastrophic injury in rugby union is no greater than that encountered in many daily activities. Hence a reasonable conclusion from the comparison would be that the risk of catastrophic injury in rugby union is at an acceptable level. This conclusion is further supported by the view that higher levels of risk are normally accepted when the risks are taken on voluntarily, such as for sports activities. For example, there has been no attempt to prevent people from taking part in mountaineering even though 1 in 3 of all mountaineers who successfully climbed Mount Everest subsequently died from climbing activities (Law, 2007).

The risk associated with catastrophic injuries in rugby union can also be evaluated from the perspective of the characteristics of the Dread/non-dread and Known/unknown dimensions of risk (Table 1). Here catastrophic injuries sustained in rugby union would be categorised as having largely known, non-dread characteristics and this would place the risk in the region where one would not expect to hear calls for regulatory intervention, which is in agreement with the findings of Fischhoff et al. (1978) for sport participation in general (Figure 2). This conclusion is also strongly supported by the responses to a recent letter in the British Medical Journal (Bourke, 2006), where the author called for the banning of all contested scrums in rugby union on the grounds that there was a risk of spinal cord injury. Of the 25 responses to this letter (up to 11 June 2007), 24 of the respondents were against the call for a ban (British Medical Journal, 2007). Among the many reasons given for this opposition in the responses were: voluntary participation by the players, the known risk undertaken by the players and a generally lower risk of sustaining a catastrophic injury in rugby union than in many other common activities. Whilst the responding group were not a randomly selected sample of the rugby population, all the respondents were directly involved with the game of rugby union in one way or another and virtually all were or had been players. The current limited evidence therefore suggests that there is a general perception that the risk associated with catastrophic injury in rugby union is at an acceptable level.

5.3 RISK REDUCTION STRATEGIES IN RUGBY UNION

A high level of risk does not make a risk unacceptable, *per se*, as people will accept risks that are taken on voluntarily at levels up to 1,000 times higher than risks taken on a non-voluntary basis (Trimpop and Zimolong, 2007); in fact for many athletes the feeling of excitement created by high-risk sports is their *raison d’être* for participation. An important consideration in risk reduction is the concept of risk compensation in which people will sometimes adopt higher risk strategies following the introduction of risk mitigation measures in the belief that they are operating in a safer environment (Hedlund, 2000). For example, the introduction of wide-ranging technical improvements in car safety over the last 50 years has had little impact on the overall level of
fatalities on the road in the UK and other countries. This effect is claimed to be the result of risk compensation and risk homeostasis, whereby drivers feel that they can drive more aggressively because of the improvements in car safety. It has been suggested that similar risk compensation effects occur in sport in general (Hagel and Meeuwisse, 2004) and, relevant to the discussion here, in rugby union in the context of the use of headgear (Finch et al., 2001).

In order to recognise the potential pathways for reducing the level of catastrophic injuries in rugby union, it is important to understand the circumstances in which catastrophic injury can occur and how the incidence of these injuries may be affected (Figure 4).

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**Figure 4: Factors influencing the incidence of catastrophic injuries**

Catastrophic injuries can occur during both training and match situations with the level of risk during these activities affected by the actions of, for example, coaches, referees and other players. The first requirement to be satisfied in order to evaluate the effectiveness of any intervention, however, is the existence of a comprehensive database for recording the incidence and causes of catastrophic injuries.

### 5.3.1 Reporting procedures for catastrophic injuries

Claims and counter-claims persist about the incidence and causes of catastrophic injuries in rugby union; unfortunately, most of these claims are based on limited information. This situation will
undoubtedly continue until large scale epidemiological studies are implemented using national registers of catastrophic injuries; however, because the incidence of catastrophic injury is extremely low, it would be impossible for any individual to implement a meaningful prospective epidemiological study without the full support of a national or international rugby body (see: Section 5.1). At the present time the RFU relies on incomplete information to assess the number, nature and cause of catastrophic injuries: the limitations of the RFU injury reporting procedures were recognised and highlighted by the RFU CITG in their Report to the RFU Management Board in April 2007.

Since 2002, details of any catastrophic injuries sustained by full England and Premiership first team players during competition and training would also have been reported through the England Rugby Injury Audit and full details of the cause of the injury would be recorded. Up to the present date, however, no catastrophic injuries have been recorded by this system. Although one catastrophic spinal injury was sustained by a player during an England U-21 training session in 2005, this group of players were not included in the Injury Audit. Division 1 rugby clubs since 2005 and a selection of Academy and Schools since 2006 have been included in injury surveillance studies implemented by the RFU Community Rugby Medical Group. Again, no catastrophic injuries have been recorded in either of these studies. Outside of these groups, up until and including the season 2006/07, all other clubs and schools have been asked to report the following injury events to the RFU Community Rugby Sports Injury Administrator (RFU, 2007a):

> *An injury which results in admission to a hospital intensive care unit, high dependency unit, specialist spinal or head injury unit.*

> *Deaths which occur during or within 6 hours of a game finishing.*

> *Any injury that is likely to result in an insurance claim to the RFU insurers.*

There were a number of disadvantages with this system. The major disadvantage being that the system was limited to a simple number counting procedure. The Report Form did not collect detailed injury diagnosis or injury causation information. There was also a specific statement on the Report Form that the ‘RFU only uses this data for contacting individuals and/or their clubs who are identified as requiring support in the case of a serious injury.’ This effectively meant that the RFU could not use the information collected about catastrophic injuries for any other purpose. The problem that concerns all injury surveillance studies is the need to obtain informed consent to record medical information about players’ injuries. There was also a lack of reliable information about the level of exposure to the game of rugby union, which restricted calculations on the incidence of catastrophic injury. This lack of detailed information on injury causation and exposure meant that it was difficult to develop and evaluate injury prevention strategies. Following the recommendations of the RFU CITG, the RFU reporting system will be modified from the start of the 2007/08 season (RFU 2007b), when only injuries defined as:

> *An injury which results in admission to a hospital.*

> *A deaths which occurred during or within 6 hours of a game finishing.*

will be reported to the RFU Sports Injuries Administrator. The statement limiting the use of the reported information will be removed from the new Injury Report Form. The intention is that detailed information about the nature and cause of each catastrophic injury will be obtained during follow-up visits to the injured player by the RFU Injured Player Welfare Officer. The operation of the new procedures should be audited at the end of the 2007/08 season in order to assess its effectiveness.
Establishing an effective catastrophic injuries database should remain as a major priority for the RFU. There are a number of other models that the RFU could consider as the basis for establishing a national registry of catastrophic injuries:

New Zealand Rugby Union depends on the government funded Accident Compensation Corporation (ACC, 2007) database of catastrophic injuries, which is part of a national no-fault insurance scheme. This scheme among other things provides personal no-blame injury insurance cover for all sportspeople in New Zealand. The system uses the American Spinal Injury Association scales (Sci-Info-Pages, 2007) to classify spinal injuries but the database does not provide detailed information about injury causation. The basic information collected by ACC must therefore be supplemented with detailed data collected by the New Zealand Rugby Union Injury Prevention Group on the ‘Serious Injury Report Form’, which should be completed by the player’s team manager or the match referee. This Report Form provides information on the type and site of injury and the phase of play in which the injury was sustained (New Zealand Rugby Union, 2007).

South Africa Rugby (2007) is in the process of establishing a database of catastrophic spinal injuries through the University of Cape Town and Medical Research Council Research Unit for Exercise Science and Sports Medicine. Their aim is to collect information about numbers and causes of injury. The database, however, is under development so it is not possible to assess its success at this stage.

The National Center for Catastrophic Sport Injury Research (NCCSIR, 2007) in the USA collects and communicates information about catastrophic sports injuries related to the brain and spinal cord. The NCCSIR, which has operated since 1982, is funded by the National Collegiate Athletic Association (NCAA), the American Football Coaches Association, and the National Federation of State High School Associations. Data were originally collected for American Football but the scope of the NCCSIR work was expanded to cover all sports undertaken at US Colleges and High Schools. Some information is also collected on injury causation. The database has been successfully employed for 25 years and has provided a useful source of information to evaluate the effectiveness of interventions in American Football (NCCSIR, 2007).

At the present time, it is difficult to evaluate the effectiveness of intervention studies in rugby union due to the lack of detailed information about the incidence of catastrophic injuries in any country, with the possible exception of New Zealand. The Rugby Football Union should therefore establish a registry of catastrophic injuries together with information about the type, site and cause of the injury for all standards of play together with the collection of information about the size of the exposed population at each standard of play. Cameron et al (2004), in reviewing Australia’s first statewide trauma registry, concluded that registries can produce high quality data but that adequate funding and resources were essential to ensure their success. The Rugby Football Union should publish an analysis of the results from such a registry on an annual basis on the Rugby Football Union web pages in order to satisfy the risk management requirement to communicate levels of risk to stakeholders. In addition, the Rugby Football Union Management Board should encourage the International Rugby Board in their initiative that all countries affiliated to the iRB should establish similar catastrophic injury reporting systems and an analysis of the results from this international survey should be reported on an annual basis on the iRB web pages.

5.3.2 Post-injury management of catastrophic injuries

Sekhon and Fehling (2001) estimated that one third of all new cases of paraplegia and quadriplegia in the USA died before they reached hospital. Decisions made at the scene of a spinal cord injury and within the first 24 hours following injury are therefore extremely important in determining the long-term consequences of this type of injury. The concept of specialist Spinal Injury Centres (SICs) has been adopted in several countries in the belief that immediate referral to a SIC results in a better patient outcome than referral at a later date. Jones and Bagnall (2004), however, stated in a
recent review that it was not possible to reach a conclusion on this issue as there was no valid evidence available. These authors concluded ‘all of the studies identified were retrospective observational studies and of poor quality’.

The RFU (2004) Community Rugby publication entitled ‘Tackling Safety’ states: ‘Every club should have ... a chartered physiotherapist or medically trained person in attendance at every match who is responsible for the management of acutely injured players’. This situation does not exist at all clubs and schools. Therefore, if a player sustains a catastrophic injury at a club or school where this guidance has not been adhered to, the club/school would have to defend their decision not to comply with the RFU guidance if a legal case for compensation were to be brought by the injured player. Whilst there is always the risk of catastrophic injury, the risk assessment indicates that the risk is no greater than in many other situations, where there is no requirement for a medically trained person to be present. Other risk mitigation measures, such as ensuring access to a hospital emergency service, may therefore be more appropriate to the level of risk and be achievable.

5.3.3 Player, coach, referee and club guidance on catastrophic injuries

High quality coaching is of paramount importance for reducing the incidence of catastrophic injuries in the tackle and scrum. Internationally, there has been no concerted effort to address the issue of catastrophic injury in rugby union. The RFU coaching group has made significant contributions to the management of situations with a propensity to cause catastrophic injuries. In this respect the Community Rugby Group currently produces a range of documents (RFU, 1999), web pages and a DVD entitled ‘Tackling Safety: Peak performance and injury prevention’ (RFU, 2004), which provide general information and guidance on the correct tackling and scrummaging procedures. Injury prevention also forms a part of the RFU coaching and refereeing training courses. The technical quality of these courses should however be reviewed by suitably qualified experts in these areas of play. The International Rugby Board (2007) modified the laws related to scrummaging in January 2007 in order to reduce the risk of catastrophic injury during this phase of play. However, the absence of good quality baseline injury data will make it extremely difficult to evaluate the effectiveness of this measure.

The RFU Community Rugby publication entitled ‘A-Z of Community Rugby’ (RFU 2007c), provides guidance to clubs and schools on spectator, ground and clubhouse safety but the document does not discuss player safety. There is also an absence of a coherent, multidisciplinary approach to player safety at club and school levels, as local web sites often do not refer to player safety or provide links to the RFU Community Rugby web pages on this subject. The RFU should therefore encourage all clubs and schools with web pages to provide active links to the centralised, co-ordinated RFU Community Rugby web pages, as these provide a consistent, comprehensive information base that can be updated on a regular basis. The RFU Community Rugby Group produces an extensive list of articles within their Technical Journal, which is available on the RFU web site (RFU, 2007d). However, none of the articles presented since 2004 relate specifically to catastrophic injury or to the prevention of injury in general. There are, however, a number of articles that are indirectly related to the prevention of injury, such as micro-stretching, social support for injured players, heat stroke and nutrition. Regular articles on different aspects of injury prevention, treatment, rehabilitation and return to play would be a welcome addition to the range of articles presented and this would create a broader understanding of the importance of these issues to players and clubs.

New Zealand Rugby Union has made a large commitment to the issue of injury prevention through the launch of the RugbySmart (2007) injury prevention programme for players, coaches and officials in 2001. The RugbySmart programme is implemented and supported by the New Zealand national injury insurance scheme. The programme, which can be accessed on-line or through a DVD, provides a comprehensive programme of training and injury prevention strategies with
separate sections for players, coaches and officials. The programme is currently compulsory in New Zealand rugby for all coaches and referees, who must retrain on an annual basis if they wish to continue their duties. It has been claimed that the introduction of the RugbySmart programme achieved a significant reduction in the incidence of catastrophic injuries in the scrum in the period from 2001 to 2005 (Quarrie et al., 2007). This conclusion, however, was based on limited data and the assessment of changes in small numbers of injuries is notoriously difficult. Historically, the level of catastrophic injury in New Zealand has been high and the claimed reduction in the incidence of catastrophic injuries still leaves New Zealand rugby with a higher incidence of catastrophic injury than that achieved in England with the RFU’s existing procedures. Whilst the RugbySmart programme delivered a reduction in the incidence of injury in the controlled environment of the scrum, it did not achieve a reduction in the incidence of catastrophic injuries in the less controlled environments associated with rucks, mauls and tackles (Quarrie et al., 2007).

In summary, RugbySmart provides an advanced compulsory injury prevention training programme for scrummaging and tackling activities in rugby union. The evidence to support the need for all coaches and referees to undergo annual retraining has not been demonstrated however. RugbySmart is a useful, structured training programme that potentially has great benefits but it is too early, at this stage, to judge its overall success for reducing the incidence of catastrophic injuries. It should also be recognised that the New Zealand approach operates within a different health and injury compensation framework than that operating within the UK.
6.0 CONCLUSIONS

The study has assessed the level of risk associated with catastrophic injuries in rugby union in England and in other countries in the Northern and Southern hemispheres. The level of risk in rugby union has been compared with other sports, other activities and the Health and Safety Executive’s guide values for negligible, acceptable, tolerable and unacceptable levels of risk. The key conclusions from this study are:

- There is a lack of high quality epidemiological data related to catastrophic injuries in rugby union in England; the Rugby Football Union should therefore implement the proposal presented by the RFU CITG to establish a registry of injuries that can be used to monitor the incidence of catastrophic injuries over time and to evaluate the effectiveness of intervention studies. This registry should also record the nature and causes of the injuries and identify the magnitude of the population at risk.

- There is a lack of high quality epidemiological data related to catastrophic injuries in all countries and the Rugby Football Union Management Board should encourage and support the International Rugby Board in establishing registries of catastrophic injuries in all affiliated countries.

- The levels of risk for catastrophic injuries in rugby union in England and Ireland fall within the Health and Safety Executive’s guide values for an ‘acceptable’ level of risk.

- The levels of risk for catastrophic injuries in rugby union in other countries are higher than those found in England and Ireland and fall within the Health and Safety Executive’s guide values for a ‘tolerable’ level of risk.

- The levels of risk for catastrophic injuries in rugby union in England are comparable with those observed internationally in other contact/collision team sports.

- The levels of risk for catastrophic injuries in rugby union in England are comparable with those observed in work-related situations in the UK.

- The levels of risk for catastrophic injuries in rugby union in England are lower than those observed in traffic-related activities.

- Whilst there are a number of injury management, coaching and refereeing guidelines related to injury prevention within the Rugby Football Union, there does not appear to be a structured, coherent, multi-disciplinary approach, which is required to address the issue of catastrophic injuries. At the present time, the New Zealand RugbySmart injury prevention programme may provide the best option for developing a suitable strategy in England. However, it should be recognised that the New Zealand approach operates within a different health and injury compensation framework than that operating within the UK.
7.0 REFERENCES


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