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## ANALYSIS



## Rugby injury surveillance and prevention programmes: are they effective?

Despite the high rates of injury in rugby, the UK government plans to focus on increasing participation in the sport in schools. **Andreas Freitag**, **Graham Kirkwood**, and **Allyson Pollock** discuss whether surveillance and prevention programmes from around the world have reduced rugby injuries

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Since rugby union became a professional sport in 1995 its popularity has increased such that the Six Nations Championship in 2014 had a higher average attendance per game than either the UEFA Euro Cup 2012 or the FIFA World Cup 2014.<sup>1 2 3</sup> Rugby (both union and league) is the third most popular team contact sport worldwide.<sup>4</sup> Rugby union is played in around 120 countries and rugby league in around 40.<sup>5 6</sup> England has the largest number of rugby union players in the world—over two million, which is almost 40% of the world total.<sup>5</sup>

The high rates of injury in rugby union and rugby league for professional and amateur players, including children, are well established and a cause for medical concern.<sup>7-13</sup> Around 12% of child and adolescent rugby players sustain an injury severe enough to require at least seven days' absence from playing in a season.<sup>12</sup> A meta-analysis of rugby injuries among adult rugby union players found an overall incidence of injury of 81 per 1000 player hours,<sup>14</sup> three times that of child and adolescent players (26.7 per 1000 player hours).<sup>12</sup> So adult players can expect to be injured once every 9.3 matches on average, assuming that each match is 80 minutes long.

Recent high profile cases have exposed the mismanagement of concussion on the rugby field, sometimes with fatal consequences.<sup>15 16</sup> The risk of concussion and reduced cognitive and motor function in later life is also high in other collision sports including American football and ice hockey.<sup>17 18 19</sup> In the United States a settlement of at least \$1bn (£680m; €940m) has been granted preliminary approval by the judge in a case against the National Football League brought by former players over failure to inform them of the risks of concussion.<sup>20</sup> Multiple autopsy findings reveal chronic traumatic encephalopathy in the brains of former professional wrestlers and players of American football, ice hockey, and rugby.<sup>19 21 22</sup>

The aim of this paper is to establish whether rule changes and injury prevention strategies around the world have been successful in reducing injury rates in rugby.

### Collecting data

Establishing rates of rugby injury in populations at risk requires good quality data. However, comprehensive injury surveillance systems that capture injuries occurring on the field and in training—across professional and amateur, adult and child, rugby union or rugby league—are lacking in every country except New Zealand. A comprehensive player database in New Zealand provides denominator data on injuries, as players per year by age and sex, which is essential for evaluating the effects of rule changes and prevention strategies (Ken Quarrie, personal communication, 2015).

The Rugby Football Union, the governing body for rugby union in England, only requires injuries that result in admission to hospital or death to be reported.<sup>23</sup> But it also funds the Community Rugby Injury Surveillance Project, which collects data on type and severity of rugby union match injuries from a sample of clubs. The number of participating clubs grew from 12 in 2008-09 to 109 of about 900 clubs in 2010-11.<sup>11 24</sup> Although serious injuries, defined as any that require hospital treatment,<sup>25</sup> should be reported to the Scottish, English, and Irish Rugby Football Unions, their websites do not have a visible section on injury reporting and statistical monitoring. The Welsh Rugby Union does not provide any information about their policy on injury surveillance and reporting on their website. No countries other than New Zealand have compared the reliability, completeness, or accuracy of injury reports held by rugby unions with rugby injuries reported in hospitals, community health services, and schools.

New Zealand has a comprehensive national dataset of rugby injuries, which have been collected since April 1974 by the Accident Compensation Corporation (ACC). This organisation provides financial compensation and support to everyone who suffers an injury irrespective of proof of blame or citizenship.<sup>26</sup>

The ACC's three pillars are data collection, injury prevention, and injury compensation. Claims are either made by the claimant themselves or are automatically submitted in the case of a hospital admission.<sup>26 27</sup> An evaluation report published in 2008 that focused mainly on the effectiveness of injury compensation found that the ACC performed well compared with other systems because of its broad coverage, low costs, and holistic approach to case management.<sup>28</sup> Crucially, the ACC also provides ongoing assistance and compensation for seriously injured players including income support and funds for alterations to houses and vehicles. The ACC data system runs separately from data collection by the New Zealand Rugby Union. Team managers or referees should report any injury to the head or neck, any that require hospital admission, and any that stop a player from playing for eight weeks or more through a standardised injury report form provided by the New Zealand Rugby Union on their website.<sup>29</sup>

## Mechanism of injury

Systematic reviews have found that most rugby injuries occur during the tackle but that scrums are the most dangerous phase of play. This is because they have a high rate of injury relative to their short duration and a tendency to produce more severe injuries, especially in rugby union. An analysis of ACC data showed that between 1976 and 2000 48% (33 of 69) of permanently disabling spinal injuries occurred during the scrum, whereas 36% (25 of 69) occurred during the tackle.<sup>30</sup> By 2001-05, after preventive measures had been taken, scrums accounted for 12.5% (1 of 8) of such injuries and tackles for 87.5% (7 of 8), and the number of permanently disabling spinal injuries had fallen to eight—nearly half of the number predicted (18.9) based on the previous period, presumably due to rule changes.<sup>30</sup> Being tackled generally accounts for more injuries than active tackling.<sup>12</sup>

## Preventive measures

Effective prevention strategies, such as rule changes, must be informed by data—that is, aimed at the tackle and the scrum. The reduction of permanently disabling spinal injuries in New Zealand is mainly due to a 97% fall in scrum related injuries.<sup>30</sup> Scrum injury rates have declined considerably in rugby league in Australia since non-contested scrums were introduced in 1996.<sup>31</sup> In 2009 World Rugby, the global governing body for rugby union, approved a number of rule changes concerning the scrum and the lineout (a way of restarting the game) after years of evaluation, and in 2010 it adjusted the rule concerning dangerous forms of the tackle (table⇓). Further rule changes were approved in 2012 and 2013.<sup>32</sup>

Differences in physical size and maturity at the same age are a feature of children's development and may be associated with injury.<sup>34</sup> Thus, matching child rugby players by size rather than age, as is done in some parts of New Zealand, may help reduce the frequency of the most severe injuries.<sup>35</sup> Current rules of play for boys and girls are set out in the data supplement on thebmj.com. In "rugby sevens" the smaller number of players (seven rather than 15) is thought to lead players to look for gaps rather than contacts, although there is evidence of a higher incidence of concussion and of severity of concussion in professional rugby sevens than rugby 15s.<sup>36</sup>

The New Zealand Accident Compensation Act 2001 places a legal duty on the ACC "to promote measures to reduce the incidence and severity of personal injury."<sup>37</sup> All measures have to be coordinated with governmental departments to create an efficient and effective injury prevention system. ACC data have

successfully been used to inform injury prevention through the SportSmart programme. This 10 point injury prevention programme has been the template for similar initiatives focused on specific sports, including rugby, netball, football, and snow sports.

For example, in 2001 the New Zealand Rugby Union with the ACC introduced RugbySmart, which aims to educate coaches about player condition, safe techniques in contact phases of the game, and injury management.<sup>38</sup> The Australian Rugby Union operates SmartRugby, an occupational health and safety programme, which is similar to the educational component of RugbySmart.<sup>39</sup> Both programmes are mandatory for all coaches and referees. In 2008 the South African Rugby Union introduced BokSmart.<sup>40</sup> Also modelled on RugbySmart, it aims to achieve behavioural changes to reduce catastrophic injuries. These three programmes focus on good injury management and primary prevention. Warm-up, safe playing techniques, and the rules of fair play are a large part of the programme.<sup>38 41 42</sup>

In Scotland the "Are You Ready to Play Rugby?" programme was launched in 2009. It covers all ages and is tailored to specific age groups; youth programmes aimed at 11 to 16 year olds focus on the tackle, ruck (a loose scrum), core stability, and speed and agility, whereas programmes aimed at over 16s focus more on anti-doping measures.<sup>43</sup>

In England the FMC:RUGBY project, a collaboration between the Rugby Football Union and the University of Bath, is an upcoming injury surveillance and prevention system.<sup>44</sup> The project aims to collect injury data from participating schools for under 15s, under 16s, and under 18s and to develop new warm-up and training programmes.

## Effectiveness of injury prevention strategies

The Van Mechelen injury prevention model has four steps: establish the extent of the problem, establish the aetiology and mechanism of the sports injury, introduce preventive measures, and evaluate the effectiveness of prevention strategies by repeating step one.<sup>45</sup> Only RugbySmart and BokSmart have completed all four steps. Effectiveness has been evaluated by three studies; two for RugbySmart<sup>27 30</sup> and one for BokSmart.<sup>46</sup> Both programmes claim to have been successful in reducing the number of injuries and introducing behavioural changes among players. Improvements are especially seen in changes in behaviour that target catastrophic injuries.<sup>27 30 46</sup>

The importance of such programmes is highlighted by the fact that rates fell only for targeted injuries. Following the implementation of RugbySmart, the rate of moderate to serious injury claims for targeted areas of the body (including neck, spine, shoulder, and knee) fell from 1689 to 1449 per million players from 2001 to 2005. Over the same time period the rate of claims for non-targeted areas (including hand, arm, and head) increased slightly from 770 to 773 moderate to serious injury claims per million.<sup>27</sup>

Although there have been no evaluations of RugbySmart published since 2009, a report on New Zealand national news in 2014 said that moderate to serious injuries had dropped by 15% since the introduction of the programme in 2001.<sup>47</sup> However, the report also showed that the number of concussion claims for rugby union increased by about 22% from 594 in 2010 to 723 in 2013. Entitlement claims, where the ACC has to pay for more than just medical treatment (for example, injury related loss of earnings, home help, or vocational rehabilitation), rose from 22 to 47 in the same period (ACC, personal

communication, 2015). The ACC partially attributes the rise of claims to increased awareness.<sup>47</sup> Comparisons with other countries are difficult owing to differences in study populations and injury measurement.

It is also important to understand the effectiveness of individual approaches and to tackle any challenges that could endanger the success of such programmes.<sup>48</sup> The success of RugbySmart was largely down to an explicit recognition that a substantial proportion of injuries occurred during the tackle and that cooperation with rule changes required the involvement of experts, whose opinions were respected by players, coaches, and spectators.<sup>49</sup>

## UK government plans

The UK government has selected rugby union and rugby league among the five sports it will focus on to increase the prominence of competitive sport in schools in England. Announcing the coalition government's new youth sports strategy, Jeremy Hunt promised to "work with sports such as football, cricket, rugby union, rugby league, and tennis to establish at least 6000 partnerships between schools and local sports clubs by 2017." The government hopes to put 1300 links in place between schools and rugby union organisations, and 1000 links with rugby league.<sup>50</sup> But most rugby injury surveillance and prevention programmes established since the late 2000s have not been evaluated. The safety of the game, effectiveness of prevention programmes, and recent changes to the laws of the game are unknown.

Given that children are more susceptible to injuries such as concussion and often take longer to recover fully,<sup>51</sup> the government's plan to increase funding of and participation in rugby in schools in the absence of a comprehensive system for injury surveillance and prevention (including tertiary prevention and rehabilitation) is worrying. Only by collecting injury data and by providing feedback to individuals and organisations working on safety initiatives will the short and long term effects of injury prevention programmes, whether for rugby or any other sport, be known.

Many countries, including the UK, have inadequate child injury surveillance systems. Under the United Nations Convention on the Rights of the Child governments have a duty to protect children from risks of injury. As a signatory to the convention, the UK government should ensure the safety and effectiveness of sports and that injury surveillance and prevention strategies are established before proceeding with its plans to target funding and increase participation in a high risk collision sport such as rugby.

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**Key messages**

Formal public injury surveillance and prevention systems have been successfully established for rugby in New Zealand

Injury prevention programmes must be evaluated to ensure a successful approach to reducing injury rates

Most rugby injury surveillance and prevention programmes have not completed all steps of Van Mechelen's injury prevention model, so the effect of injury prevention initiatives on reducing injuries and optimising the outcomes of injury is not known

The effectiveness of recent rule changes has yet to be evaluated

The UK government plan to fund and to increase participation in rugby in schools has not been informed by injury data and is happening in the absence of systems for injury surveillance and prevention

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## Table

**Table 1 | Selected changes to the rules of rugby union for the tackle and the scrum**

Year	Tackle	Scrum
<b>World Rugby<sup>32</sup></b>		
2005		3.13(a): If after a front row player has been sent off or during the time a front row player is temporarily suspended there are no further front row players available from the nominated team, then uncontested scrums will be ordered
2009	10.4(e): Tackling above shoulders considered dangerous play 10.4(i): Lifting a player off the ground and driving the player into the ground while the feet are still off the ground such that the player's head and/or upper body come into contact with the ground first is considered dangerous play	20.3(f): All players in a scrum, other than front-row players, must bind on a lock's body with at least one arm prior to the scrum engagement
2010	10.4(h): A player must not charge into ruck or maul	Changes to scrum formation for under 19s rugby in part 20.1(f)
2011	10.4(j): Lifting a player off the ground and driving the player into the ground while the feet are still off the ground such that the player's head and/or upper body come into contact with the ground at all is considered dangerous play	
<b>Rugby Football Union<sup>33</sup></b>		
2014		No player to take part in scrums until he has reached his 18th birthday; uncontested scrums to be used when a front row player is required to be replaced and there is no suitable front row replacement available, or when the referee deems it unsafe to start or continue a match with contested scrums