

SUMMARY

“BokSmart is a nationwide education programme that aims to prevent injuries, but particularly catastrophic injuries, in all South African rugby players through coach, referee and player education. This thesis evaluated if the programme has achieved these goals. Quite simply, the programme has been successful: in the period after BokSmart’s introduction (2010-2013) there has been a reduction by two catastrophic injuries, per year, in junior (schoolboy) players. Reasons for the rate in seniors remaining unchanged may be related to greatly difficulty in changing older players’ behaviours.”

With the world becoming increasingly physically inactive, there is currently more emphasis on being physically active than ever before. Rugby union (‘rugby’) is a particularly popular form of physical activity, globally. This popularity is also continuing to increase. In South Africa, rugby is exceptionally popular with between 400,000 – 600,000 players. Unfortunately, all forms of physical activity also carry a risk of injury to the participant – the risk of which depends on the type of activity. With 81 injuries per 1000 match hours, rugby carries a high risk of injury to the participant. In the worst-case scenario, these injuries can be ‘catastrophic’ or permanently life-altering in severity. Although the rate of catastrophic injuries in rugby is empirically classified as ‘acceptable’, this rating does not necessarily reflect the opinion of the general public and the scientific community. This opinion is influenced by the permanent nature of catastrophic injuries that affect not just the sufferer, but also the sufferer’s family and friends. Ultimately, the wellness of participants in a sport is the responsibility of the sport’s federation. In South Africa, the rugby federation is the South African Rugby Union (SARU).

The New Zealand Rugby Union demonstrated that it was possible to reduce injuries in their sport through a nationwide education programme called *RugbySmart*. Based on the principles of *RugbySmart*, SARU developed and launched their own nationwide injury prevention programme for South Africa: BokSmart (www.boksmart.com). The name ‘*BokSmart*’ is based on the nickname of the country’s national rugby team, the Spring**bo**ks. The strategy of *BokSmart* was

similar to its predecessor (*RugbySmart*) in that it aimed to educate all coaches and referees in the safest techniques for rugby. By doing this, it was anticipated that the programme would reduce the number of catastrophic injuries in players. While the sport enjoys equal prominence and popularity in both South Africa and New Zealand, the countries are otherwise very different. South Africa has a far greater variance in socioeconomic status (SES) than New Zealand. According to the United Nations Human Development Index (HDI), New Zealand is among the most developed countries in the world (7th in 2014), while South Africa ranks somewhere in the middle (118th in 2014) of the same scale. Although the success of the intervention has been established in New Zealand, it stands to reason that the success may be different in South Africa. Therefore, the aim of this thesis was to systematically evaluate the *BokSmart* programme in South Africa. In particular, the thesis attempted to answer two questions: 1. 'Does South African rugby have an injury problem?'; and 2. 'Is the *BokSmart* injury prevention programme effective?'

1. DOES SOUTH AFRICAN RUGBY HAVE AN INJURY PROBLEM?

"No - not worse than other rugby-playing nations, although there are some injury risk factors that need to be addressed and therefore an injury prevention programme is necessary for South African rugby..."

The goal of the first results chapter (Chapter 2) was to establish if injury rates were higher in South Africa than other countries. This chapter attempted to answer this question through a prospective study at four highly competitive youth tournaments. With 23.1 injuries per 1000 match hours, the rates at these tournaments were not different to comparable international literature. However, this chapter also established particular types of injuries, such as concussions, that required particular attention from *BokSmart* programme implementers.

Using the same data from Chapter 2, the financial cost of treating these injuries from a medical insurer's perspective were presented in Chapter 3. At US\$731 per injury, these injuries were a large economic burden to the families. However, if these costs were distributed among all tournament players and not just those that required follow-up treatment, the cost would only be US\$14 per player. Chapter 3 also established that fractures were particularly costly injuries to treat. Also, the

presence/absence of medical insurance clearly affected injury treatment and, quite possibly, ultimate rehabilitation, before the injured players returned to play. This is an issue that is specific to a developing country such as South Africa: in New Zealand everyone's injury costs are covered by national insurance, not just those that can afford the high cost of medical insurance, as occurs in South Africa. Thus, this information is important to optimising the focus the *BokSmart* programme.

The goal of Chapter 4 was to establish the incidence of catastrophic injuries in South Africa. Despite widespread perceptions of high rates and therefore an 'injury problem', this has not been established empirically with a nationwide prospective epidemiological study. Thus, these data were collected prospectively by SARU to answer this question. Contrary to perceptions, with an annual catastrophic injury rate of 2.0 per 100,000 players, South Africa did not have higher rates than other countries, and the risk could be classified as 'acceptable'. Nonetheless, the specific risk factors for catastrophic injury were still important for the *BokSmart* programme. For example, senior (adult) players had injury rates over 10 times greater than junior players and the hooker playing position and scrum phase of play accounted for high proportions of all injuries.

The scrum is a one of the most strictly regulated phases of play and occurs relatively infrequently and should have a correspondingly low risk of injury. Although the tackle phase of play is generally associated with the highest risk of injury, it was hypothesised that this risk of injury during the scrum was being underestimated. In this chapter, it was suggested that this resulted from an overestimation of the total number of players at risk of injury in the exposure calculation. Scrum-related neck injuries generally only occur to three ('front-row') of the eight forwards who are involved in this phase of play. Thus, using data from Chapters 2 and 4, the effect of injury rates, when only the front-row was considered in the calculation, was examined in Chapter 5. When the players in the scrum who actually suffered these injuries were considered (i.e. front-row), injury rates were as much as five times higher than had been reported previously, when all eight players in the scrum were considered in the calculation. Therefore, this chapter suggested that despite its regulation and infrequency, the scrum might be carrying a high injury risk for the front-row forwards.

2. IS THE BOKSMART INJURY PREVENTION PROGRAMME EFFECTIVE?

“Yes – there has been a reduction in catastrophic injuries in juniors (schoolboys). Identified barriers to BokSmart working optimally should be addressed: this includes the reduction in senior (adult) players and negativity from well-off schools/clubs.”

Chapter 6 examined whether the programme was associated with a reduction in catastrophic injury rates over time – which is also SARU's main goal for the programme. Using data from Chapter 4, this chapter showed that BokSmart had been associated with a reduction of 2.5 injuries (this number was rounded down to 2 for practical interpretation in the summary at the start of this section) per year in juniors since the programme's introduction. There was no change in injury rates in senior players over the same time period. While an age effect was not demonstrated in the evaluation of RugbySmart in New Zealand, there was only one injury after the implementation of the programme, thereby nullifying any potential for an age effect. In South Africa, the lack of effect on injury rates in older players is concerning, considering the findings of Chapter 4 that demonstrated that senior players are a higher greater risk of suffering a catastrophic injury. However, the effect in juniors could be explained simply by the fact that there were far more participants in this age group, and thus there was greater potential for effect. Alternatively, this finding could also indicate that the programme was working better in juniors than seniors.

The aim of Chapter 7 was to investigate evidence of the adoption of safer player behaviour since the implementation of the *BokSmart* programme. Therefore, this chapter examined self-reported questionnaire data collected by SARU at its annual tournaments. In doing so it was established that half ($n = 9$) of all behaviours that were tested had 'improved' according to *BokSmart's* pre-established definitions of what was correct or incorrect. More importantly, *BokSmart's* targeted behaviours - practicing of safe scrummaging and tackling techniques - were two of the nine behaviours that improved over this period.

Chapter 8 was a qualitative evaluation of the coaches and referees' perceptions of the BokSmart programme. These perceptions were established using focus groups and telephonic interviews. The RE-AIM (Reach, Effectiveness, Adoption, Implementation and Maintenance) framework was used to categorise the findings. Coaches' perceptions were largely determined by their socioeconomic status (SES).

In general, low SES coaches and referees were positive about the course and its potential to reduce catastrophic injuries. The negativity described by high SES coaches was related to them thinking they knew the information provided by the programme already, but also described difficulties in changing coach and player behaviour. The negativity of low SES coaches was more related to their lack of infrastructure that they felt inhibited the adoption of *BokSmart* techniques.

CONCLUSION AND SUGGESTIONS TO IMPROVE BOKSMART

Despite the identified barriers to success in Chapter 8, the *BokSmart* programme was associated with a reduction in catastrophic injuries in junior players (Chapter 6). This main goal could have been achieved through the improvements in targeted player behaviour that were identified in Chapter 7. The lack of effect on injury rates in senior players could be partly explained by the barriers identified in coaches and referees through qualitative research in Chapter 8 or the fact that there are more junior players and therefore greater chance of having an effect. The identified barriers included negativity towards the programme of high SES team coaches and difficulty in changing player behaviour, even after attending the *BokSmart* compulsory safety course. To extend the programmes' effect to senior players, *BokSmart* should attempt to reduce as many of these barriers as possible. Furthermore, once these junior players become senior players with time, it is anticipated that the positive effect of *BokSmart* will naturally spread to this age group. The following modifications to the *BokSmart* programme are suggested to reduce some of the identified barriers:

1. Adapt the compulsory biennial safety course for coaches and referees, based on their feedback: reduce the length, make the course more practical and interactive and tailor the programme based on league position of the attendees.*
2. Continue player behaviour and catastrophic injury rate to provide regular, contemporary feedback to stakeholders, players, coaches and referees about the effectiveness of the programme. This includes evaluating safety law/regulation changes that were promulgated by *BokSmart*.
3. Add in a longitudinal evaluation of the programme of coaching/referee behaviour and of general (non-catastrophic injuries) to gain further insight

- about how the programme is working or failing: this may help to explain the differences in the change of injury rates in junior/senior players.
4. Have a summarised 'refresher' safety course for attendees who are renewing their certification within two years.
 5. Provide an option for a basic, rugby-focused, first aid course to safety course attendees. Also, provide optional informal workshops between the biennial safety courses on topics of interest to the end-user such as nutritional supplement use.
 6. Employ '*BokSmart* police' to check, at random, that regulations are being followed as prescribed.*
 7. Pose a catastrophic injury scenario to the safety course attendees to ensure that they have thought through the emergency plan logistics for their particular context.
 8. Add random, qualitative assessment measures (telephonic interviews or focus groups) to the current *BokSmart* course evaluations to get regular and longitudinal feedback on the programme from the coaches, referees and players that the programme targets.

**BokSmart* /SARU have made these changes on their own accord in the time that the thesis was
been written and examined