Football is the game played by more participants internationally than any other at all levels.

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He has been awarded Life Membership of the South African Sports Medicine Association and is a member of the American College of Sports Medicine. He was Venue Medical Officer for Ellis Park for the FIFA Confederations Cup in 2009 and has also been appointed to this position for the 2010 FIFA World Cup South Africa.

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Table I. Incidence of football injuries in different countries

<table>
<thead>
<tr>
<th>Country</th>
<th>Level of play</th>
<th>Injuries per 1000 game hours</th>
<th>Injuries per 1000 training hours</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MALES</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Iceland</td>
<td>National elite, first league</td>
<td>24.6</td>
<td>2.1</td>
</tr>
<tr>
<td>Sweden</td>
<td>Sr. National team</td>
<td>30.3</td>
<td>6.5</td>
</tr>
<tr>
<td>Sweden</td>
<td>National top division</td>
<td>25.9</td>
<td>5.2</td>
</tr>
<tr>
<td>US</td>
<td>MLS professionals</td>
<td>35.5</td>
<td>2.9</td>
</tr>
<tr>
<td>UK</td>
<td>Premier League, 1st and 2nd division</td>
<td>25.9</td>
<td>3.4</td>
</tr>
<tr>
<td>Finland</td>
<td>Highest national league</td>
<td>25.9</td>
<td>3.4</td>
</tr>
<tr>
<td>Sweden</td>
<td>1st division</td>
<td>21.8</td>
<td>4.6</td>
</tr>
<tr>
<td></td>
<td>2nd division</td>
<td>18.7</td>
<td>5.1</td>
</tr>
<tr>
<td></td>
<td>3rd division</td>
<td>16.9</td>
<td>7.6</td>
</tr>
<tr>
<td></td>
<td>6th division</td>
<td>14.6</td>
<td>7.5</td>
</tr>
<tr>
<td>Denmark</td>
<td>2nd division (high)</td>
<td>18.5</td>
<td>2.3</td>
</tr>
<tr>
<td></td>
<td>Series (low)</td>
<td>11.9</td>
<td>5.6</td>
</tr>
<tr>
<td><strong>FEMALES</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sweden</td>
<td>Senior players, various skill levels</td>
<td>14.3</td>
<td>3.7</td>
</tr>
<tr>
<td>Sweden</td>
<td>Premier, 2nd division</td>
<td>24</td>
<td>7</td>
</tr>
<tr>
<td><strong>YOUTH (&lt;18y)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>New Zealand</td>
<td>Schoolboy</td>
<td>16.2</td>
<td>3.7</td>
</tr>
<tr>
<td>Switzerland</td>
<td>High level males</td>
<td>18.7</td>
<td>4.1</td>
</tr>
<tr>
<td></td>
<td>Low level males</td>
<td>21.7</td>
<td>8.2</td>
</tr>
<tr>
<td>Denmark</td>
<td>Male youth</td>
<td>14.4</td>
<td>3.6</td>
</tr>
</tbody>
</table>

The FIFA World Cup is an enormous event unlike any other sporting event, and attracts hundreds of millions of television viewers around the world. The player participants are as much sports stars as they are entertainers, and their wellbeing is paramount to them, as it is to their fans and to football officials. From a player point of view, at whatever level of play, be it at school or as a highly paid professional, avoiding and reducing injury severity is very important. An understanding of injury incidence, mechanisms of injury and prevention strategies is therefore essential to achieve that outcome.

The sporting code that has proactively been at the forefront of systematically maintaining records of injuries, and promoting research in the field, is football, through the code’s Fédération Internationale de Football Association (FIFA). Research by
F-MARC (FIFA Medical Assessment and Research Centre) has been extensive, and has included epidemiological studies since 1994, with a recent FIFA publication summarising these results. These studies have included over 50 publications in peer-reviewed journals, and this work is continuing internationally. The aims of these studies have been to document the incidence of injuries, to assess aetiological factors and to identify risk factors for injuries. A further ongoing important objective is to assess the effectiveness of injury prevention programmes.

In adult football there is broad evidence that a previous injury represents an important risk factor for another injury.

'Prevention should always be our priority and it is even more important when treatment possibilities are restricted. The new F-MARC, The 11+ – a complete programme to prevent injuries, has proved successful in reducing injuries in general by a third and severe injuries by half. I feel it is not only more important, but might prove to be even more effective in African players' (Professor Jiri Dvorak, MD, FIFA Chief Medical Officer and Chairman of the FIFA Medical Assessment and Research Centre, F-MARC).

### Table II. Exposure time and average number of injuries in different age and skill-level groups

<table>
<thead>
<tr>
<th></th>
<th>Adult players</th>
<th>Youth 16-18y</th>
<th>Youth 14-16y</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Top</td>
<td>3rd league</td>
<td>Amateur</td>
</tr>
<tr>
<td>Training hours</td>
<td>307.4</td>
<td>337.1</td>
<td>184.3</td>
</tr>
<tr>
<td>Game hours</td>
<td>51.3</td>
<td>60.2</td>
<td>46.3</td>
</tr>
<tr>
<td>Training/game ratio</td>
<td>6.0</td>
<td>5.6</td>
<td>4.0</td>
</tr>
<tr>
<td>Injury per player</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>2.0</td>
<td>1.8</td>
<td>2.1</td>
</tr>
<tr>
<td>Mild</td>
<td>.86</td>
<td>.71</td>
<td>.94</td>
</tr>
<tr>
<td>Moderate</td>
<td>.95</td>
<td>.68</td>
<td>.59</td>
</tr>
<tr>
<td>Severe</td>
<td>.19</td>
<td>.45</td>
<td>.53</td>
</tr>
</tbody>
</table>

'Prevention should always be our priority and it is even more important when treatment possibilities are restricted. The new F-MARC, The 11+ – a complete programme to prevent injuries, has proved successful in reducing injuries in general by a third and severe injuries by half. I feel it is not only more important, but might prove to be even more effective in African players' (Professor Jiri Dvorak, MD, FIFA Chief Medical Officer and Chairman of the FIFA Medical Assessment and Research Centre, F-MARC).
Incidence of injuries

The incidence of football injuries in different countries is listed in Table I. Irrespective of the different definitions of injury used in the literature, it is believed that the risk of injury in football is high compared with other sports.24 In general, the risk of injuries in football varies according to the definition of injury, the research design1 and a number of characteristics of players,6 such as age7 and skill with respect to level of play.8 Professional adult football players have a risk of injuries that is incomparably higher than that observed in employees in most other occupations.9

The injury incidence in adult male players ranges from 12 to 35 injuries per 1 000 hours of match play and 1.5 - 7.6 injuries per 1 000 hours of exposure.10 On average every elite male football player incurs approximately 1 performance-limiting injury each year.11 The incidence of match injuries is on average 3 - 6 times higher than the incidence of injuries during training.11,12 Data on injury incidence and risk factors in youth and adolescent players are scarce and inconsistent. An earlier study found that male senior players sustain more injuries than youth players, based on incidence of football injuries per 1 000 hours of match play.11 A review of epidemiological data in 2005 classified youth football as a relatively safe sport with an injury incidence ranging from 2.3 per 1 000 practice hours to 14.8 per 1 000 match hours.13 A Swedish study of 1 800 players aged 13 - 16 years recorded injury rates of 2.4 - 6.8 injuries per 1 000 playing hours and concluded on a low injury rate in football, recommending the match to increase physical activity in the youth (Table II).14 In a prospective epidemiological study of youth academy players over two seasons, the Football Association (FA) observed a higher risk of injury in the age group of 17 - 19 years compared with players aged 9 - 16 years.15 A cohort study in French elite youth players observed an injury rate of 4.8 per 1 000 hours exposure time with no significant difference between the age groups of 14, 15 and 16 years.16 As seen in adults, too, injury rates in training were lower (3.9) compared with matches (11.2 per 1 000 hrs). Studies also indicate that most injuries in youth players occur at the lower extremities (Fig. 1).11,13,15 Ankle sprains are the most common injury, with contusions and strains being the most frequent types of injury.15 Head injuries in youth football seem rare. Fractures and dislocations account for approximately 3 - 12% of injuries (Fig. 2).17 In adult football there is broad evidence that a previous injury represents an important risk factor for another injury.21,23 This also seems to apply to youth players.20,21

The tackle in football is a direct extrinsic cause of injury. Video analysis of tackling situations in a study by Fuller et al.26 revealed that of 8 572 tackles from 123 match recordings in 3 FIFA tournaments, 40.4% were fouls, 44% of injuries requiring off-field medical attention were fouls, 74% of post-match reported injuries were from the tackled player and tackles from the side and behind were twice as likely to require post-match medical attention. Further analysis indicated that different tackling situations had the greatest tendency for specific players, and included clash of heads (both tackler and the tackled), two-footed tackles (the tackled), tackles from the side (tackler), jumping vertically (tackler). The laws of the game need to be continually revised to ensure that players are protected from serious injury. This has already been evident where lifting arms in jumping actions is prohibited to prevent elbow to head/face injuries, and forward straight leg tackles. Referees only play a part in so far as their eyes (including assistants) can take them, and therefore a culture of fair play is necessary and is actively promoted by FIFA through Fair Play.

Injury frequency and characteristics vary with different styles of play, but also between countries and geographical regions.

Football injuries in Africa and South Africa

Injury frequency and characteristics vary with different styles of play, but also between countries and geographical regions (Table I).14,22 The incidence of football injuries in South Africa is unknown, as no large epidemiological studies have been conducted. One study31 showed that the 1-year prevalence rate of injuries in 103 first team high school female football players from nine schools in Johannesburg was 46.1% and the point preamble was 37.8%. The main sites of injury were the knee (18.6%) and the ankle (17.6%). Another report from a study at one hospital over a 42-month period states: "Thirty-two patients were admitted with severe injuries. The injuries included 18 fractures of the tibial and femoral shaft. Two tibial shaft fractures were compound. Four tibial plateau fractures and five epiphyseal injuries were identified. One patient had a fracture-dislocation of the hip. One patient with a popliteal artery injury presented 48 hours after the injury had occurred. He had an above knee amputation. In the same period 122 patients were treated as outpatients. The types of injury in this cohort were similar to soccer injuries reported in other countries.33"

There is not much research from elsewhere in Africa. A recent study in the British Journal of Sports Medicine reported a prevalence of 81.6% injury in 196 players from premiership, professional, national and state amateur clubs in Benin City, Nigeria. Ankle sprains were the most prevalent (25%), followed by the knee (20%). Most were deemed to be moderate in severity for (28%).3

Prevention of injuries in football

Despite the known high risk of injuries in football, systematic approaches to prevention are poorly documented in the literature and were for a long time limited mainly to small populations. A randomised study 25 years ago in 180 senior male players included a broad spectrum of measures from information, prophylactic taping, correction of training to rehabilitation and followed them for 6 months, achieving an injury reduction of 75% (calculated as injuries per team per month) in the intervention group with a significant reduction of the most common injuries in football.3 However, this study did not relate injury incidence to exposure time, so the results might have been influenced by varying exposure to match play and training in the intervention and control group.

In a more recent study the effects of a pre-season conditioning programme (cardiovascular conditioning, plyometric work, sport-specific drills, strength training and flexibility exercises to improve speed and agility) on the occurrence of football injuries in 42 out of 300 female high school players were investigated during 1 year of competitive football.29 Significantly fewer players in the intervention group were injured (14%) compared with the control group (33.7%). Again, injury incidence was not related to exposure time, and age, skill level and performance variables in the intervention and control groups were not considered and, if considered, might have influenced results differently.
**Football injuries**

**The 11+**

**PART 1  RUNNING EXERCISES  •  8 MINUTES**

1. **RUNNING STRAIGHT AHEAD**
   - Exercise: Run across the pitch, from one side to the other, at 70-80% maximum pace.
   - Aim: Improve running endurance and speed.
   - Duration: 4 minutes, 2 sets.

2. **RUNNING HIP OUT**
   - Exercise: Run to the first pair of cones at 70-80% maximum pace. Bend your hips and knees, then jump and land on one foot, which is bent. Repeat the exercise for 30 seconds.
   - Aim: Strengthen hip flexors and gluteal muscles.
   - Duration: 2 sets.

3. **RUNNING SHOULDER COUCH**
   - Exercise: Run forwards to the first pair of cones at 70-80% maximum pace. Grasp your arm and shoulder to make a small circle with your body. Repeat the exercise for 3 minutes.
   - Aim: Improve shoulder and upper body stability.
   - Duration: 2 sets.

4. **RUNNING QUICK FORWARDS & BACKWARDS**
   - Exercise: Run forwards and backwards to the first pair of cones at 70-80% maximum pace. Aim to land on both feet with your hips and knees bent. Repeat the exercise for 3 minutes.
   - Aim: Enhance dynamic balance and coordination.
   - Duration: 2 sets.

**PART 2  STRENGTH  •  PLYOMETRICS  •  BALANCE  •  10 MINUTES**

1. **THE BENCH STATIC**
   - Starting position: Sit on the floor with your back against a bench. Extend your legs in front of you. Press your hips upwards, keeping your knees straight, until your legs are completely straight. Hold for 30 seconds. Repeat 3 times.
   - Aim: Strengthen gluteal and hamstring muscles.
   - Duration: 3 sets.

2. **SINGLE-LEG STANCE HOLD THE BALL**
   - Starting position: Stand with your feet hip-width apart. Imagine that there is a ball between your legs. Bend your knees and hips, bringing your body to a 90-degree angle. Hold this position for 30 seconds. Repeat 3 times.
   - Aim: Improve single-leg balance and stability.
   - Duration: 3 sets.

3. **SQUATS WITH TOE RAISE**
   - Starting position: Stand with your feet hip-width apart. Lift your heels off the ground, keeping your knees straight. Hold this position for 30 seconds. Repeat 3 times.
   - Aim: Develop lower body strength and balance.
   - Duration: 3 sets.

4. **JUMPING VERTICAL JUMPS**
   - Exercise: Stand with your feet shoulder-width apart. Jump as high as you can, landing on both feet. Repeat the exercise 10 times.
   - Aim: Enhance vertical jump and overall explosive power.
   - Duration: 3 sets.

5. **RUNNING ACROSS THE PITCH**
   - Exercise: Run across the pitch, from one side to the other, at 70-80% maximum pace.
   - Aim: Improve running endurance and speed.
   - Duration: 4 minutes, 2 sets.

6. **RUNNING BOUNDING**
   - Exercise: Run with high landing and 2-step. Land gently on the ball of your foot, using your leg muscles to stir up the body. Jump and land on the ball of your foot, then repeat the exercise for 30 seconds.
   - Aim: Enhance explosive power and leg speed.
   - Duration: 2 sets.

7. **RUNNING PLANT & CUT**
   - Exercise: Run with high knees while moving at 80% maximum pace. Jump and plant right on the ball of your foot. Quickly cut in the opposite direction, then return to the starting position. Repeat the exercise for 30 seconds.
   - Aim: Improve agility and speed.
   - Duration: 2 sets.

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**Fig. 3. The 11+ warm-up programme.**
Other prevention studies focused particularly on specific injury types, for example the most common injury type in football, i.e. ankle sprains. A study of 55 male senior football teams followed up for 6 months demonstrated that ankle disk training and wearing of an orthosis prevented sprains in players with previous ankle problems.20 A study in South Africa prospectively evaluating the effect of a semi-rigid orthosis over the course of one playing season showed a significant reduction in recurrence of ankle sprains.30 No preventive effect was observed for players without previous ankle sprains.

A recent review of interventions for preventing ankle ligament injuries including five randomised trials concluded that external ankle support reduces the number of ankle sprains.31 This reduction was shown to be greater for athletes who had previous ankle sprains but was also evident in those without prior sprain.

**The tackle in football is a direct extrinsic cause of injury.**

With regard to other injury types, in a study including 40 semi-professional and amateur football teams prospectively followed over three seasons, a proprioceptive training programme significantly reduced the incidence of injuries to the anterior cruciate ligament.32 In another study concentrating on hamstring strains, eccentric training combined with warm-up stretching significantly reduced the risk of hamstring strains in male elite football teams, while no effect was detected from flexibility training alone.33 The impact of stretching on sports injury risk has not sufficient evidence to endorse or discontinue routine stretching before or after exercise to prevent injury among competitive or recreational athletes.34

The evidence with regard to the effect of prevention programmes in youth and adolescent football is even more limited. One of the largest prevention studies was conducted in female players between the ages of 14 and 18.35 Over 2 years, a total of 1 041 female players from 45 teams (of a total of 52) received a football-specific training programme consisting primarily of neuromuscular and proprioceptive training. An F-MARC prevention study in male youth amateur players, published in 2002,26 observed a reduction of injuries in general of 20 - 36%, depending on the outcome criteria.

A 2004 review showed few well-designed and controlled studies investigating strategies to prevent injuries in sports in general, and an even smaller number with regard to such strategies in children and youth.37 While most authors acknowledged the need for more research, they unanimously advocated prevention programmes in youth players.13-15,38

A larger randomised controlled trial assessed the effect of the F-MARC 11 in 2 100 female players aged 14 - 16 years.39 The ten exercises of the programme, complemented by Fair Play, were designed to reduce injuries of the lower extremity as the most common injuries in football. Half of the teams were asked to perform the 11 exercises prior to each training and match play over a whole season. No differences in injury risk were observed in the F-MARC 11 group compared with the control group. However, compliance in this study was found to be low as the teams in the intervention group performed the programme in only half of their training sessions during the first half of the season. This may indicate the importance of compliance and the minimum activity required to prevent injury, or rather that less than 50% compliance will not reduce injury incidence.

In a consequent study, the effect of The 11+ – a complete warm-up programme to prevent injuries was assessed (Fig. 3).40 Based on the previous experiences, The 11+ programme was developed to improve both the preventive effect of the programme and the compliance of coaches and players. The programme includes key exercises from The 11 and the PEP programme, but also additional exercises to provide variation and progression. Further, it includes structured running exercises that make it a comprehensive warm-up programme for training and matches. In a cluster randomised controlled trial, 125 football clubs in Norway corresponding to about 2 540 female players aged 13 - 17 years (approx. 1 320 players in the intervention and approx. 1 220 players in the control group) were followed for one league season of 8 months. Coaches were asked to perform the complete exercise programme as a warm-up prior to each training session, and to perform the running exercises as part of their warm-up prior to each match. During the season there was a significantly lower risk of any injury, overuse injuries and severe injuries in the intervention group compared with the control group. The reduction of match injuries, training injuries lower extremity injuries, knee injuries, and acute injuries ranged from 26% to 38% but was not statistically significant.

**In football, studies have shown that upper limb to head contact in heading contests accounted for approximately 50% of concussions.**

**Head injury and concussion**

In football, studies have shown that upper limb to head contact in heading contests accounted for approximately 50% of concussions. Fair play and respect for opponents are ethical values which must be encouraged, not only with players, but also coaches, parents and managers. This will go a long way in reducing concussion in football.

The reader is referred to the 'Consensus Statement on Concussion in Sport – The 3rd International Conference on Concussion in Sport' held in Zurich, November 200841 and the article covering this topic in this journal edition.

References (41) available on request.

**In a nutshell**

- The incidence of injuries in football is 12 - 35 injuries per 1 000 hours of match play and 1.5 - 7.6 injuries per 1 000 hours of exposure.
- Injury rates in training are lower than in matches.
- Most injuries occur at the lower extremities.
- Previous injury is another high risk factor.
- The tackle in football is a direct extrinsic cause of injury, and Fair Play is important in reducing such injuries.
- Preventive strategies with specific training programmes significantly reduce the incidence of injuries.
- Prevention of injuries should always be a priority and is even more important when treatment possibilities are restricted, as in many parts of Africa.