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## Sports Injuries

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# **CHAPTER 1**

## **GENERAL INTRODUCTION**

### **Sports participation – a cornerstone of public health**

How much we move our body has an enormous impact on our health. The human body was designed to move.<sup>1</sup> However, current levels of physical inactivity cause a major public health problem.<sup>2-4</sup> Physical inactivity has a negative impact on health and quality of life, it is associated with premature death,<sup>5</sup> and is responsible for a substantial economic burden to society.<sup>6</sup> The promotion of physical activity is, therefore, crucial for public health.<sup>1-6</sup>

The benefits of a physically active lifestyle are well-documented. These benefits include improvement of several indices of health<sup>7</sup> and a reduction of non-communicable disease risk, such as cardiovascular diseases, diabetes type II and certain types of cancer.<sup>8,9</sup> Moreover, regular physical activity is also associated with higher life expectancy<sup>10,11</sup> and with healthy ageing.<sup>11,12</sup>

Sports are powerful avenues for the promotion and maintenance of sufficient levels of physical activity worldwide.<sup>1,8</sup> Further, sports are high-impact vehicles for humanitarian, population-development, and peace-building efforts that are applied by (non-)governmental organisations, development agencies, sporting federations, armed forces and the media.<sup>13</sup> As such, the promotion of sports participation is a current global effort and should be seen as an investment in the present and in the future.<sup>1,8,13</sup>

### **Sports-related injuries hamper sports participation**

Despite the well-documented benefits of sports participation, sports also entail a risk of unwanted consequences; e.g. injuries.<sup>14</sup> Consequently, people partaking sports as part of a healthy lifestyle can be discouraged to continue with sports participation. The negative experience related to injuries is one of the main reasons for children dropping out of organised sports participation.<sup>15</sup> This dropping-out hampers public health efforts in promoting participation in sports at a young age. Sports and physical activity for young people are especially important given that they can improve people's control over symptoms of anxiety and depression, and assist in social development by offering opportunities for self-expression, social interaction and integration.<sup>16</sup> Moreover, when

physically active, young people are more likely to adopt other healthy behaviours, such as the avoidance of alcohol, tobacco, and other recreational drugs, as well as to perform better academically.<sup>16</sup> The prevention of sports injuries is, therefore, important for public health.<sup>17</sup>

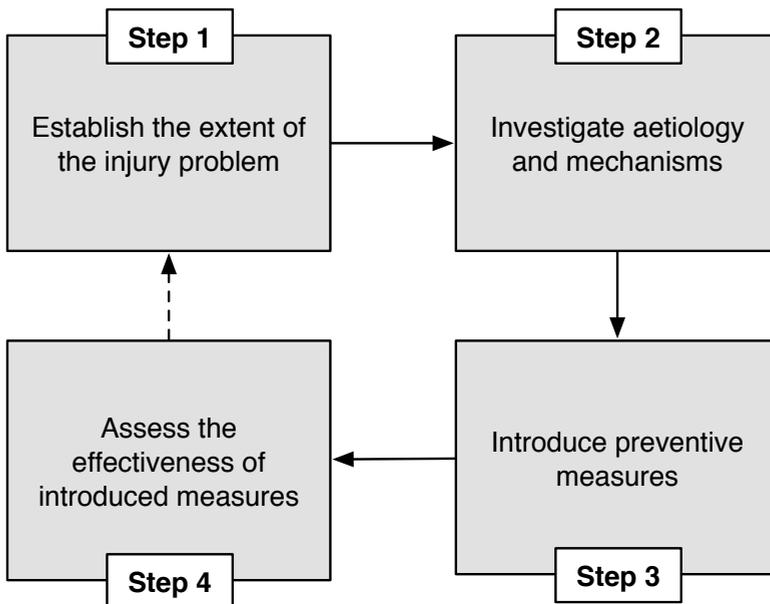
Apart from the burden on individual's health, sports injuries also hamper the athletic success of individuals and teams.<sup>18</sup> This is especially important for elite sports, where athletes and teams need to perform at their best regularly. Injuries decrease athletes' availability for training and competition throughout the season and, consequently, reduces the chance of athletic success. This leads to lower positions in the final ranking of competitive seasons.<sup>18</sup> Therefore, injury prevention is of great importance and should be a priority for protecting athletes' health and for maximising athletic performance.<sup>18,19</sup>

### **Sports-related injuries are preventable**

Given the multi-faceted negative impact of injuries, safety in sports is an essential corollary of the global effort to promote sports participation. The prevention of sports injuries is an important goal for researchers, clinicians, as well as for society as a whole.<sup>20</sup> Active injury prevention ensures safe sports participation for people throughout their lifespan.<sup>14</sup> Fortunately, the knowledge on prevention of sports injuries has grown exponentially over the last decades.<sup>21-23</sup> Based on the current-available knowledge, it is reasonable to state that it is possible to significantly reduce the risk of injuries for most participants in a wide array of sports. However, applying evidence-based (cost-)effective injury prevention measures under 'real-world' conditions is still an ongoing challenge.<sup>24</sup>

Effective prevention of sports injuries is the outcome of a systematic process. Multiple frameworks have been proposed to guide injury prevention research in sports.<sup>25-27</sup> A widely-accepted and -applied model is the four-step sequence proposed by van Mechelen et al.<sup>25</sup> (Figure 1). In this so-called sequence of prevention, the first step is to establish the extent of the injury problem in terms of incidence and severity. The

second step is to investigate the aetiology and mechanisms of injuries recorded in step one. The third step is to develop and introduce a preventative strategy. Lastly, the fourth step is to evaluate the effectiveness of the strategy introduced in the third step. The fourth step can be done using a time-trend analysis as illustrated by the dashed line in Figure 1, or preferably by a (randomised) controlled trial.



**Figure 1.** The sequence of prevention of sports injuries. Adapted from van Mechelen et al.<sup>25</sup>

**This thesis aims to facilitate the prevention of sports-related injuries**

***Outline of the thesis***

The studies described in this thesis are presented in the context of the sequence of prevention proposed by van Mechelen et al.<sup>25</sup> (Figure 1). **Chapters 2–5** refer to the first step of the sequence; i.e. establishing the extent of the injury problem. The second and third step of the sequence of prevention (i.e. investigating injuries aetiology and mechanisms, and introducing preventative measures, respectively) were conducted through a partnership between a sporting association and a social organisation

interested in promoting healthy behaviour and preventing sports injuries. The documentation of the steps conducted by this partnership can be found elsewhere.<sup>28-</sup><sup>30</sup> **Chapters 6–7**, subsequently, regard to the fourth step of the sequence of prevention of sports injuries (i.e. assessing the effectiveness of a preventative strategy). Lastly, **chapter 8** discusses the main findings presented in chapters 2–7 and their implications. Chapter 8 also comprises a general discussion of the methods applied in the studies presented in the chapters mentioned above, as well as practical recommendations for future efforts for the prevention of sports injuries.

### ***Specific study objectives***

As mentioned, the first step towards effective prevention of sports injuries is to establish the extent of the injury problem.<sup>25-27</sup> It is not possible to address preventative efforts if one does not know what injuries exist in the first place. Monitoring sports injuries is, therefore, essential in order to commence preventative efforts. **Chapter 2** of this thesis presents a narrative review of relevant concepts for monitoring sports injuries and discusses the practical application of such concepts. Chapter 2 can, as such, serve as a primer for stakeholders interested in the monitoring of sports injuries to establish a focus for preventative efforts.

Since measuring the extent of the injury problem is the first step towards prevention,<sup>25-</sup><sup>27</sup> one needs an injury-monitoring system to commence preventative efforts.<sup>31</sup> Chapter 3 and 4 present a real-world application of an online sport-health monitoring system built based on the concepts described in chapter 2. **Chapter 3** describes the acceptability and perceptions of end-users (i.e. elite judo, swimming, and volleyball athletes and their team staff members) towards such a system. Understanding the perspective of end-users towards a monitoring system is important because they are the ones who should use such a system in real-life situations. Therefore, chapter 3 is useful for those interested in designing and/or implementing an online system for monitoring athletes' health.

**Chapter 4** presents the output of such an online sport-health monitoring system in terms of injury incidence, prevalence, and severity. It concerns injuries experienced during a season of Dutch elite field hockey players. Field hockey is a popular Olympic sport worldwide<sup>32</sup> and is among the most popular sports in the Netherlands.<sup>33</sup> Yet, despite its popularity and long history, few prospective studies have investigated the overall magnitude of the injury problem in this sport.<sup>34</sup> To contribute to the understanding of the injury problem in field hockey, chapter 4 presents the extent to which injuries impact health and hamper training/competition participation and performance in elite field hockey. In addition, the systematic review in **chapter 5** provides a summary of the descriptive evidence of injuries in this sport.

In an attempt to reduce the risk of injury in field hockey, the Royal Dutch Hockey Association (KNHB) and the Dutch Consumer Safety Institute (VeligheidNL) have partnered. Together with field hockey and injury prevention experts, they had developed, already before the start of this PhD-trajectory, a structured exercise-based injury prevention program; i.e. the Warming-up hockey program.<sup>28-30</sup> At the request of both organisations, this program was evaluated as part of this PhD. Therefore, **chapter 6** portrays the results of a quasi-experiment to evaluate the effectiveness of the Warming-up hockey regarding its potential to reduce injuries in youth players. Correspondingly, **chapter 7** is aimed to be a resource for stakeholders interested in understanding and interpreting common study designs, outcome measures, and statistics used in studies evaluating the effect of injury prevention strategies in sports. Chapter 7 provides a foundation for those involved in the decision-making process and applying research findings in the area of injury prevention in their sporting setting.

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## CHAPTER 1

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