

## **Chapter 1**

# **General introduction and outline of this thesis**

### **Benefits of physical activity in children**

Participation in physical activities promotes physical and mental health, as well as social well-being. Also children benefit from being physically active. It has been shown that participating in physical activities lowers for example the risk of poor cardiovascular fitness, obesity, and type 2 diabetes mellitus<sup>1-3</sup>. Furthermore, physical activities can enhance psychological well-being and may reduce low self-esteem, symptoms of depression and anxiety<sup>1,4</sup>. In addition, adequate physical activities during childhood is of great importance for the development of various skills, such as the ability to recognize size, shape, position, depth and to experience the advantages of teamwork during team activities and to deal with winning and losing<sup>5</sup>.

### **Side effects of physical activity in children**

It is clear that regular participation in physical activities will have many physical and psychological health benefits for children. However, a decline in recent years of being physically active and an increase in sedentary behaviour of children are reported. As a result, the percentage of obese Dutch children aged 2-20 years has increased. To decrease overweight in children, all children are nowadays stimulated to meet the daily guideline for healthy physical activity (60 minutes moderate to vigorous physical activity). With this current focus on decreasing overweight and stimulating a healthy lifestyle through physical activities in children, an increasing number of children that participate in physical activities can be expected. However, a negative side effect of participating in physical activities is physical activity-related injuries.

In the Netherlands, yearly 1.5 million acute sports injuries occur in children and adults. Of these, 50% has to be treated medically<sup>6</sup>. Sport injury incidence rates in the Dutch population aged 18-34 and 35-54 years are respectively 1.2 and 0.8 per 1,000 hours sport participation. The highest injury incidence rate is found in children aged 4-17 years, namely 1.3 injuries per 1,000 hours of sport participation<sup>7</sup>.

Injuries as a result of physical activities also lead to high direct and indirect health care costs. In the Netherlands, the direct and indirect health care costs of sport-related injuries are respectively 170 million and 420 million euro per year<sup>8</sup>. The direct and indirect costs of pediatric sport injuries specifically are not known.

If children sustain an injury this may cause pain, short term disability, school absence or at a later age long-term consequences such as osteoarthritis<sup>9,10</sup>. When older, children may also lose their enthusiasm for participating in physical activities, because of the negative association of sport participation and injuries<sup>11,12</sup>. Because of the relatively high injury incidence in children, the argued high health care costs and the short and long-term consequences of injuries for children, injury prevention is necessary.

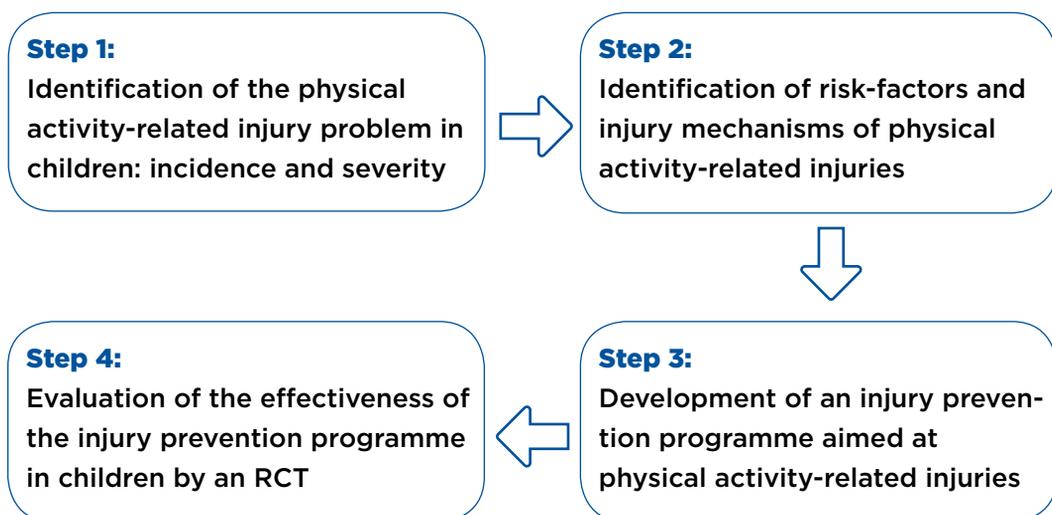
## Injury prevention in children

Although it is impossible to eliminate all injuries, attempts to reduce them by using injury prevention measures are important. Measures to prevent sport-related injuries can be developed along the lines of the 'sequence of prevention' model as suggested by van Mechelen et al. (1992)<sup>13</sup>.

This model is based on four steps including (step 1) establishing the extent of the sports injury problem by describing incidence and severity, (step 2) establishing etiology and mechanism of sports injuries, (step 3) introducing preventive measures and finally, (step 4) assessing their effectiveness.

Often the development of preventive measures focuses only on the prevention of sport-related injuries. However, children participate most of their time in leisure time activities<sup>14</sup>. Therefore, activities aiming at injury prevention in children should not focus exclusively on sports clubs or sports organizations. Furthermore, although sport participation in children has increased, membership of sports clubs has decreased<sup>15</sup>. There is a large number of children participating in organized team sports, but a growing number of children is attracted to unorganized sports activities and individual sports. Thus, the four steps of the 'sequence of prevention' model should not focus only on sports-related injuries, but on the entire scope of physical activity-related injuries when developing preventive measures for children (figure 1.1).

**Figure 1.1:** The sequence of prevention model based on van Mechelen et al. (1992)<sup>13</sup>.



### **Aim and outline of this thesis**

The main objective of this thesis is to describe the development and effectiveness of a school-based programme aimed at the prevention of physical activity-related injuries in Dutch primary school children (aged 10-12 years).

#### Chapter 2

Chapter 2 describes what is known about the steps of the 'sequence of prevention' regarding physical activity-related injuries in children. In this chapter an overview of the literature is given that deals with the various aspects of the sequence of physical activity-related injury prevention in children.

#### Chapter 3

Chapter 3 describes in detail how the school-based injury prevention programme, called iPlay, was developed according to the Intervention Mapping protocol<sup>16</sup>. To our knowledge, school-based injury prevention measures to prevent physical activity-related injuries in primary school children were at the time of programme development not available yet. The development of the iPlay-programme followed the systematic process for developing public health promotion programmes. This included: conducting a needs assessment, defining suitable programme objectives, selecting theory-based intervention methods and practical strategies, and producing programme components and materials. Furthermore, chapter 3 describes a plan to evaluate the effects of the iPlay-programme.

#### Chapters 4 and 5

Epidemiological data on the incidence, severity and costs of injuries in Dutch children of the age 10-12 are very limited. Especially data about injuries occurring during the entire scope of physical activities in children are scarce. If data are available it is hard to draw general conclusions because of methodological differences between studies. Chapter 4 describes the extent of the physical activity-related injury problem in Dutch primary school children. Based on the data collected during the iPlay-study, the injury incidence density and severity of injuries occurred during physical education classes, organised sports activities, and leisure time activities is presented. Furthermore, little is known about the costs of physical activity-related injuries in children. Chapter 5 gives an overview of the mean total: direct and indirect costs as a result of physical activity-related injuries in children based on our data derived from the iPlay-study.

#### Chapter 6

Increasing neuromotor fitness is of importance because a low level of neuromotor fitness may negatively affect children in their daily physical activity levels and in their health status in the long term<sup>118</sup>. Moreover, low flexibility, strength and general coordination have

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shown to be risk factors for injury in child and adolescent sport<sup>19</sup>.

Studies on secular changes in physical fitness in children focus especially on changes in aerobic fitness and less on neuromotor fitness. However, neuromotor fitness may be just as important as aerobic fitness in maintaining overall health and function<sup>20</sup>, since the majority of physical activities in children involve high intensity physical activity bursts, such as jumping and sprinting. Chapter 6 describes the secular changes in neuromotor fitness of Dutch children aged 9-12 years old (1980-2006). The MOtor PERformance fitness test (MOPER) measures speed, strength, general coordination and flexibility in children.

### Chapter 7 and 8

Chapter 7 and 8 describe the effects of the injury prevention programme (iPlay) on injury incidence density, injury severity, risk behaviour, and neuromotor fitness. The effectiveness is evaluated in a cluster randomized controlled trial, including more than 2,200 Dutch primary school children. Chapter 7 presents the effects of the iPlay-programme on injury incidence density and injury severity in the children participating in the study.

Chapter 8 describes the effects of the iPlay-programme on risk behaviour and neuromotor fitness. In addition, this chapter describes whether the hypothesized behavioural determinants mediated the intervention effect on behaviour.

### Chapter 9

Generally, only the effectiveness of an intervention programme is published. However, in recent years evaluating the translatability and feasibility of an intervention programme is becoming more important. Therefore, chapter 9 reports on the results of the process evaluation of the iPlay-programme. The process evaluation was designed based on the RE-AIM dimensions. The RE-AIM framework includes the following five dimensions; Reach, Effectiveness, Adoption, Implementation and Maintenance<sup>21</sup>.

### Chapter 10

Finally, chapter 10 discusses the main findings, followed by a reflection on the methodological considerations concerning the results of the iPlay-study. Moreover, recommendations for further research and practical implications are discussed.

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