

Summary



Participation in physical activities has many health benefits for children but also increases the risk of physical activity-related injuries. The work presented in this thesis describes the development and evaluation of a school-based physical activity-related injury prevention programme in Dutch primary school children. This programme, called iPlay which stands for 'Injury Prevention Lessons Affecting Youth', is evaluated using a cluster randomised controlled trial. Based on the outcome of the study, various findings are here summarised including data on the injury incidence density, injury severity, associated costs of physical activity-related injuries, and the effectiveness of the iPlay-programme in children.

Chapter 2 provides an overview on what is currently known about the prevention of physical activity-related injuries in children following the four steps of the 'sequence of prevention model'. This model describes the prevention of physical activity-related injuries in four different steps. Step 1 involves the identification of the physical activity-related injury problem in children including injury incidence and injury severity. Step 2 includes the identification of risk factors and injury mechanisms of physical activity-related injuries. Literature shows that although many studies on these issues have been published, the results are difficult to compare because of methodological differences. For instance, injury incidence, incidence severity, and risk factors may vary widely between studies as a result of variations in injury definition, in expression of injuries, in type of sport, and in target population. Step 3 of the sequence of prevention model deals with the development of an injury prevention programme aimed at physical activity-related injuries. Finally, step 4 deals with the evaluation of the developed injury prevention programme in children. As little is known about effective measures that prevent physical activity-related injuries in children, we developed and evaluated a new injury prevention programme called iPlay.

Chapter 3 describes how the iPlay-programme was developed. A great part of children's physical activities consist of leisure time activities outside sport clubs. Thus, preventive measures should not focus on sport clubs only. Schools are therefore a good setting for injury prevention lessons in order to reach all children, both physically active and less active children.

The main programme objectives of the iPlay-programme included: 1) providing injury prevention lessons so that children take fewer injury-related risks; 2) providing information to parents so that they create a safe physical activity environment outside the physical education classes; and 3) encouraging that teachers include injury prevention lessons into their teaching routine.

The iPlay-programme consisted of eight newsletters about injury prevention for children and parents, various posters to be displayed in the classroom dealing with injury prevention issues, exercises to improve neuromotor fitness, and an informative website accessible for children and parents. To evaluate the iPlay-programme, a trial was designed including

more than 2,000 Dutch primary school children aged 10-12 years old. Outcome measures were injury incidence density, injury severity, and injury costs. In addition, injury-preventing behaviour, determinants of behaviour and neuromotor fitness were measured. Furthermore, a process evaluation was designed to monitor programme implementation.

Chapter 4 and 5 describe the injury incidence density, injury severity and injury costs in Dutch primary school children. All injuries as a result of the entire scope of physical activity modalities were included such as organised sports activities, leisure time physical activities, and physical education classes. Prospective data of 996 children who participated in the control group during the iPlay-study were used to describe the physical activity-related injury problem in Dutch children. During the school year 2006-2007, injuries were reported weekly and the parents registered the costs of these injuries. In that school year, 104 out of 996 children reported a total of 119 injuries. The overall injury incidence density was 0.48 per 1,000 hours of exposure (95%CI: 0.38-0.57). Injury incidence density was lowest for leisure time activities, followed by physical education and organised sports. In general a higher injury incidence density was reported for girls compared to boys. Of all injuries 40% required medical treatment and 68% resulted in absence from sport participation. Mean total costs as a result of a physical activity-related injury were $188 \pm 317\text{€}$. The mean direct costs as a result of an injury were higher than the mean indirect costs, respectively $131 \pm 213\text{€}$ and $57 \pm 159\text{€}$. The highest costs were found for upper extremity and leisure time injuries.

Chapter 6 describes the neuromotor fitness test scores of Dutch primary school children measured in 2006 and the scores of same aged children measured in 1980. Studies on secular changes in neuromotor fitness in children are lacking because most studies focus on changes in physical fitness. However, neuromotor fitness may be just as important as aerobic fitness since the majority of physical activities in children involve high intensity bursts such as jumping and sprinting. A decrease in neuromotor fitness could negatively affect children in their daily physical activity levels and in their health status in the long term. The MOPER test, used to assess neuromotor fitness measures speed, strength, general coordination, and flexibility. Compared to 1980, the same aged children were significantly taller and heavier in 2006. Moreover, body mass index (BMI) was higher in 2006 than in 1980 in all age and gender categories. Furthermore, on all neuromotor fitness tests, performance was significantly worse in 2006 compared to 1980.

To evaluate the effects of the iPlay injury prevention programme, a cluster randomised controlled trial was conducted during the school year 2006-2007 in 40 Dutch primary schools including more than 2,200 children. Twenty primary schools performed the iPlay-programme (intervention group) and the other 20 primary schools followed the regular curriculum (control group).



Chapter 7 describes the effects of the iPlay-programme on injury incidence density and injury severity. The analyses showed a positive intervention effect on total (HR=0.81;95%CI:0.41-1.59), sport club (HR=0.69;95%CI:0.28-1.68) and leisure time injuries (HR=0.75;95%CI:0.36-1.55), although these effects were not significant due to lack of statistical power. Remarkably, the data showed that children who were less physically active had more benefit from the iPlay-programme. In this group the iPlay-programme reduced the total and leisure time injury incidence density with approximately 50% (respectively HR=0.47; 95%CI:0.21-1.06 and HR=0.43; 95%CI:0.16-1.14). Sport club injury incidence density in this group was significantly reduced (HR=0.43; 95%CI:0.07-0.75). Furthermore, children in the intervention group reported less often sporting time loss as a result of an injury than those in the control group.

Chapter 8 describes the effects of the iPlay-programme on risk behaviour and neuromotor fitness. The iPlay-programme was not able to improve injury-preventing behaviour. The programme did significantly improve knowledge and attitude, two important determinants of behaviour. The effect of the iPlay-programme on behaviour appeared to be mediated by knowledge and attitude. Improved scores on attitude, social norm, self-efficacy, and intention were significantly related to changes in injury-preventing behaviour. Furthermore, the iPlay-programme resulted in small non-significant improvements in neuromotor fitness in favour of the intervention group.

Chapter 9 describes the process evaluation of the iPlay-programme using the five dimensions of the RE-AIM framework, which included reach, effectiveness, adoption, implementation, and maintenance. The results showed that the participation rate of children was 100% (reach). The iPlay-programme resulted in a clinically relevant, but non-significant, decrease of injury incidence density as described in chapter 7. Of the invited schools 9% were willing to participate (adoption). The most given reason for not willing to participate in the study was lack of time. Participating teachers were highly positive about the iPlay-programme and implemented the programme elements as planned (implementation). The compliance with the programme of children and parents was approximately 50% and thus needs improvement.

Taken together

Injuries in children occur in the entire scope of physical activity modalities and not only during organised sport activities. Regarding injury severity of physical activity-related injuries in children our data shows that 40% of all injuries require a medical treatment and 68% resulted in absence from sport or school. Besides the physical discomfort of injuries, physical activity-related injuries in children lead also to direct and indirect costs.

Because data on effective injury prevention measures were scarce, a school-based physical activity-related injury prevention programme for primary school children was developed

and analysed on its effectiveness. An overall non-significant but substantial positive effect of the iPlay-programme was found on total, sport club, and leisure time injuries. The programme was especially effective in physically less active children, indicating that schools are an important setting for injury prevention lessons. The iPlay-programme was not able to significantly improve injury-preventing behaviour but the effect of the iPlay-programme on knowledge and attitude was found to be significant. Changes in attitude, social norm, self-efficacy, and intention were significantly related to changes in injury preventing behaviour. Finally, iPlay resulted in small non-significant improvements in neuromotor fitness in favour of the intervention group. The iPlay-study is a successful start in the prevention of physical activity-related injuries in children, but further improvements and adaptations could make the iPlay- program more effective and successful.