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8

Summary



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Physical inactivity is nowadays widely recognized as a health risk in both adults and children. The positive effects of physical activity on a child's health are numerous. Yet, many children in Europe fail to reach recommended physical activity levels. It is, therefore, not surprising that stimulating physical activity is high on the public health agenda. Increasing physical activity levels has the unfortunate side effect of an increased injury risk. In the Netherlands, over half of the individuals treated for a sport-related injury are below the age of 20. These are only the sports-related injuries, and especially young children tend to spend a substantial amount of their time in free play, i.e. a healthy activity that puts them also at risk for sustaining an injury. The costs associated with sport-related injuries have been calculated to be as high as €1,100 per event. The costs of injuries were found to be highest during free play activities, providing insight into the severity of such injuries, as compared to injuries sustained in sports. This is mainly caused by a relative high rate of upper extremity injuries (fractures) being sustained during free play. This information, combined with the fact that the number of childhood upper extremity injuries has increased over the last decade, warrants preventive measures.

How risky is physical activity?

In sports injury prevention research, the 'sequence of prevention' of sports injuries is widely used to guide preventive strategies. This sequence states that epidemiological data should serve as the basis for injury prevention programs. In this thesis, the epidemiological basis was formed by a systematic review on the injury risk during several different physical activity behaviours and the analysis of mechanisms and the of upper extremity injuries in a Danish cohort (i.e. the CHAMPS Study-DK).

The systematic review was conducted to summarise the evidence for the injury risk of several physical activity behaviours in primary school children. Physical activity enhancing programs are usually focussed on one of four modalities of physical activity, i.e. active commuting, leisure time physical activity, physical education or sports. Only studies with the number of injuries expressed per 1,000 hours of physical activity were included. The search yielded eight studies, with some studies reporting on multiple physical activity behaviours. The methodological assessment of included studies revealed that the risk of bias was low in two out of eight studies. Also, injury definitions used varied widely between the studies.

For total physical activity, incidence rates of medically treated injuries ranged from 0.15 to 0.27 injuries per 1,000 hours participation. One study reported 0.56 clinically diagnosed injuries per 1,000 hours of physical activity. The injury incidence rates related to physical education were inconsistent (they varied from 0.14 to 2.20 injuries per 1,000 hours of physical education). When considering each of the other three physical activity behaviours, sports came out as most risky (range 0.20 – 0.67 medically treated injuries per 1,000 hours of sports), compared to active commuting (range 0.15 – 0.52 injuries per 1,000 hours of active commuting) and leisure time physical activity (range 0.15 - 0.17 injuries per 1,000 hours of leisure time physical activity). Reported clinically diagnosed injury incidence rates were higher for sports and leisure time physical activity injuries, when compared to medically treated injury incidence rates. Subgroup analyses suggested that girls were at increased injury risk. Low levels of physical activity and/or physical fitness seemed to increase injury incidence levels, but the exact mechanisms remained unclear. Weight status did not increase physical activity related injury risk.

Although the injury incidence rate per 1,000 hours of activity was reported to be lower during leisure time physical activity compared to sports, the absolute number of injuries was comparable in the two domains. Thus, results suggested that injury prevention in children should focus both on sports and leisure time PA related injuries.

After assessing the injury risk for different physical activity behaviours, a special attention was paid to upper extremity injuries in children. Data were, therefore used from a Danish cohort of 1,048 primary school children (i.e. the CHAMPS Study-DK). In this cohort, with a follow-up of 2.5 year, injuries were registered weekly, using SMS text messages. Results showed that most upper extremity injuries occurred after a fall and that the risk of sustaining an injury increased with age. A tendency was found for girls to be at higher injury risk compared to boys.

Community- and school-based injury prevention

Since children with low levels of habitual physical activity have an increased injury risk, it would be more efficient to develop an injury prevention program for use outside the sports context, for example a program in the community or school context. To assess the current knowledge regarding the effectiveness of this type of injury prevention programs, a systematic review was conducted.

Eleven studies were included in this review, of which 9 were school-based. The majority of the studies focussed on the use of safety devices. For the use of safety devices, school- and community-based interventions were promising when the devices were distributed freely. The results regarding sustainability were, unfortunately, inconsistent.

An educational program to improve fall skills

To prevent upper extremity injuries in primary school children, an educational program to improve fall skills, called 'Vallen is ook een sport' was developed and implemented in the Netherlands. The effectiveness of the educational program was assessed using a cluster-randomized controlled trial. Thirty-three schools (3,317 children) were willing to participate in the study. Seventeen schools were randomized into the intervention group who received the eight weeks educational program, which consisted of weekly one hour lessons with increasing difficulty. During the study (October 2009–May 2010), fall related injuries were continuously registered.

At the end of the school-year, 36 fall-related injuries were reported in the intervention group, equalling an Injury Incidence Density (IID) of 0.14 fall-related injuries per 1,000 hours of physical activity (95%CI: 0.09 - 0.18). In contrast, 96 injuries were reported by the control group, which corresponded to an IID of 0.26 (95%CI: 0.21 - 0.32). However, because intra-cluster correlation was high (ICC =0.46), differences in injury incidence were not statistically significant. When activity level was taken into account, a tendency was found suggesting that the educational program was effective in decreasing falling related injury risk, but only in the least active children.

The effectiveness of an intervention strongly depends on the implementers, which in the current study were the teachers. To gain better understanding of the way the educational program was used, a process evaluation was conducted, based on the RE-AIM framework. This framework includes the following domains of research quality: Reach, Effectiveness, Adoption, Implementation and Maintenance.

Reach of the educational program was high, since all children who participated in Physical Education were exposed to the program. Effectiveness was promising for increasing self-perceived fall-skills and the score on a fall-skills test. However, this did not result in a significant decrease in fall-related injury rates. Fourteen percent of all schools approached for this study were willing to participate and

adopt the program. The participating teachers were generally positive about the program. Nevertheless, 89% failed to implement the exercises as intended. When asked about future use of the program, 54% of teachers intended to maintain the educational program in their regular teaching routing. The reported limitations of the program in combination with the small, yet significant, changes in fall skills conclude that a type III error cannot be completely ruled out.

The future of childhood injury prevention

Injury prevention usually follows a research driven, top-down approach. The educational program to increase fall-skills was unusual while both problem identification and the development of the educational program to increase fall skills were completed by professionals from practice. This may have resulted in some limitations from a scientific perspective, but this is presumably the best way to optimize adherence by end-users of injury prevention strategies.

In children, injuries and physical activity are closely related. Of special concern are those children who are insufficiently active. These children are more likely to have low levels of physical fitness, low muscle strength and low fundamental movement skills resulting in an increased injury risk. What may be most important for children is that they enjoy being physically active. Injury prevention should, therefore at foremost be fun. Preventive exercises can be introduced in a playful way, potentially resulting in benefits for the child at a later age.