



Original research

More children more active: Tailored playgrounds positively affect physical activity levels amongst youth



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ABSTRACT

Objectives: Overall physical activity (PA) of children is low, and the physical inactivity problem is highest in deprived neighborhoods. The overall goal of the Richard Krajicek Foundation is to provide children in deprived neighborhoods with safe public playgrounds that stimulate daily PA. This study investigates whether Krajicek playgrounds are associated with higher usage and intensity of PA compared to control playgrounds during playground use amongst children.

Design: Cross-sectional observational study.

Methods: Ten Krajicek and ten control playgrounds in The Netherlands were matched for neighborhood and playground characteristics. Usage and intensity of PA at the playgrounds were measured using direct observation (SOPLAY). Trained observers collected PA data after-school time on weekdays and weekend days. Multilevel regression analyses were performed to analyze the difference in usage and intensity of PA between control and Krajicek playgrounds.

Results: Krajicek playgrounds were significantly less often empty compared to control playgrounds (12% vs. 29%). In addition, there was a statistically significant difference in the number of boys observed on the Krajicek playgrounds (14 vs. 9, OR 1.8). Across all categories differences in playground PA were found with an average of 13% of the children on Krajicek playgrounds engaged in moderate-to-vigorous physical activity (MVPA) compared to 10% on control playgrounds. Energy-expenditure (EE) per child was higher on Krajicek playgrounds across all groups (B.006).

Conclusions: Krajicek playgrounds are positively associated with higher usage and PA intensity compared to control playgrounds. Our results indicate that Krajicek playgrounds can benefit PA of children living in deprived neighborhoods during playground play.

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1. Introduction

Physical inactivity is the fourth leading risk factor for global mortality, with a population attributable risk (PAR) of 6%.¹ Especially at a younger age physical inactivity has been associated with higher risks of being overweight or obese and with the increased risk to suffer from the resulting short and long-term negative health consequences.^{2,3} Moreover, in children and adolescents regular physical activity (PA) is associated with both physical⁴ and psychological health benefits,⁵ amongst which are increased cardiorespiratory fitness and muscular strength, reduced body fatness, favorable cardio-metabolic disease risk profiles, improved self-esteem, and fewer depressive symptoms. This shows the

importance of PA for a healthy childhood and associated benefits later in life. Yet, recent figures have shown that less than 20% of children in the Netherlands aged 12–16 years, are engaged in the recommended daily intensity of PA of 60 min of moderate intensity PA.^{1,6} As such, improving the levels of PA in children is a public health priority.

Studies have suggested that the physical environment has a great effect on the intensity of PA of children, and that physical inactivity is most prevalent in deprived neighborhoods,^{7,8} i.e. urban neighborhoods with a relatively high percentage of non-western immigrants. In general in such neighborhoods the socioeconomic status of inhabitants is lower than the national mean.⁹ Various environmental factors have been found to affect children's PA behavior,¹⁰ such as perceived neighborhood safety,¹¹ perceived playground safety,¹¹ playground supervision,¹¹ and the proximity or access to recreational facilities.^{10,12} In deprived neighborhoods these critical neighborhood characteristics are

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usually poorly represented.¹³ Based on such insights, interventions have been evaluated to promote PA through alterations of school playgrounds^{14,15} or public parks.^{11,12,16} Interventions explicitly aimed at the use of non-school, public playgrounds for PA promotion have not been evaluated to date.

In the Netherlands, the Richard Krajicek Foundation (RKF) creates public playgrounds (further referred to as Krajicek playgrounds) in deprived neighborhoods. The external factors that influence PA behavior, which are mentioned above, are taken into account in the design of the Krajicek playground. For instance, every Krajicek playground is supervised daily during peak usage times, and a designated sports coach is responsible for the organization of activities. Furthermore, loose equipment, e.g. soccer balls or jump ropes, is provided. The overall goal of the RKF is to provide public playgrounds (further referred to as Krajicek playgrounds) that stimulate daily playground PA in a socially and physically safe environment, for children of all ages in deprived neighborhoods where PA possibilities are limited. A Krajicek playground is a modified public playground with at least one, but preferably multiple, areas for children to engage in different sports or other physical free-play activities. However it remains unknown, how effective this approach is in increasing levels of playground PA as compared to regular playgrounds in comparable neighborhoods. Therefore, the aim of this study was to evaluate the children's usage and Intensity of PA at Krajicek playgrounds as compared to regular playgrounds.

2. Methods

The RKF combines public playground placements or renovations with lendable sports equipment and sports guidance to children in deprived neighborhoods. As Krajicek playgrounds are designed in reaction to calls from, and in concordance with, local government, school administrations, and local residents. All playgrounds are specifically tailored to the possibilities and needs of the specific location where a Krajicek playground is situated. For example, if a playground is located in the neighborhood with elementary schools there could be demand for a larger free-play area with swing sets and climbing apparatus for younger children. This opposed to a playground located in the neighborhood of a secondary school were sports areas could be of greater interest. Furthermore, local parties are also involved in the management, maintenance and organization of activities. Local community (sports) organizations must arrange supervision for the playground and organize events at least once a week. It is necessary that daily management is centralized and aimed at creating a (socially) safe environment. On the one hand, a safe environment constitutes of protection against, for instance, traffic by placing a fence around the playground if needed. On the other hand, a safe environment constitutes also a social benign situation in order to give all children the chance to participate in joyful PA and sports. The Medical Ethics Committee of the VU University Medical Centre, the Netherlands, approved the study design, procedures and informed consent procedure.

At the time of the study (April to July 2013) there were 99 Krajicek playgrounds throughout the Netherlands. A sample of 10 Krajicek playgrounds was randomly selected from all playgrounds that had existed at least for one year ($n=84$) to account for the novelty effect. A selection of comparative regular playgrounds (hereafter referred as control playgrounds) were matched with Krajicek playgrounds based on neighborhood and playground characteristics; i.e. the number of neighborhood inhabitants, percentage non-Western (NW) immigrants, residential density, percentage of children (0–15) living in the neighborhood, the number of households, the percentage of households with

children, the average size of households, the percentage of low-income households, the mean income of households, playground size, the number of play areas, and area purposes. All neighborhood characteristics were derived from data from CBS Statistics Netherlands.⁹ The SOPLAY (System for Observing Play and Leisure Activity in Youth) mapping tool was used to describe the playground characteristics.¹⁷ Paired playgrounds were simultaneously observed to control for factors like weather and religious events (e.g. Ramadan). Observations were not conducted when weather conditions would not allow normal playground use or when the playground was not freely accessible.

Utilization and intensity of PA were directly observed using SOPLAY.¹⁷ SOPLAY is a standardized observation method used to determine the number of children on a playground and their intensity of PA. Intensity of PA is categorized by SOPLAY as sedentary (i.e., lying down, sitting, or standing), moderate (i.e., walking or light activity), or vigorous intensity by validated codes. These activity codes have been validated by heart rate monitoring¹⁷ and permit EE to be estimated. It also documents playground characteristics, e.g. the presence of playground supervision, the possibility to borrow (sports) equipment and whether there are organized activities going on. Before the start of the observation period each playground was divided for observation purposes into target areas; i.e. observable areas for PA. For all observations two observers scanned each target area at set time intervals of 5 min. A second team of observers was added if the playground contained more than two target areas. Temperature, playground characteristics, activity type (e.g., soccer, basketball, tennis) and the categories of PA intensity of each child (i.e. sedentary, moderate or vigorous intensity activity) were reported. All playground pairs were observed for four days, three weekdays after school hours and one weekend day. A scan of all designated target areas was completed every 5 min during a two-hour period per day, resulting in 96 unique scans for each playground in total. Children of all ages were included during the scan; parents and adults other than the supervisor or sports coach were excluded from the observations.

Fifteen undergraduate University students were trained in using the SOPLAY protocol. All observations were conducted by one of the researchers together with a trained student. Training consisted of a lecture and practice observations on different playgrounds to get familiar with the SOPLAY protocol. Observers learned how to use the coding on the observation form and how to discriminate between different categories of PA intensity. Pre-recorded videos of children being physically active were used to explain the discrimination between the different categories of PA intensity and to explain the practice observation methods. Additionally, field observations were done to practice the SOPLAY method. After the practice field observations, feedback and inter-observer agreement were reported back to the observers. Inter-observer agreement was calculated separately for each observation day. Inter-observer agreement percentage ranged from 70 to 100% (mean 92%, CI 95% 90–94). Sample size: 1777 observations needed with correction for the clustered data.

Playground use is presented as: (1) the number of scans with no children present on the playground (i.e. no children during an observation); and (2) the average number of children during the scans when children were present. Additionally, mean EE per child and proportion of children participating in MVPA was calculated as a measure of PA. Following the SOPLAY protocol the estimate of EE (kcal/kg/min) was calculated by multiplying the number children with a constant for each category (sedentary; 0.051 kcal/kg/min, moderate; 0.096 kcal/kg/min and vigorous; 0.144 kcal/kg/min).¹⁷ The average number of children on the playground was calculated by summing all the counts of children divided by the number of scans. The same was done for EE. The proportion of children

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