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Review Article

Strategies for physical activity intervention in youth

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Abstract

Due to the association between insufficient physical activity (PA) and chronic diseases various policy statements emphasize the need for effective strategies to promote PA. The decline in PA is particularly pronounced during childhood and adolescence, which necessitates to start intervening at young ages. This review provides an overview of different strategies used to promote PA in youth in schools, family- or community settings. Specifically, education-based approaches, environmental changes to facilitate PA, and specific activity programs are addressed. A combination of these strategies has been shown to be more successful than only relying on a single aspect (i.e. education, environmental changes, PA programs). Most often education is used in combination with an active engagement in various forms of PA. There are also programs that rely on environmental facilitation along with health education. While such multi-component approaches have been shown to potentially increase PA during the engagement with the intervention only limited research is available on the sustainability of positive outcomes beyond the intervention period. Therefore, more research, involving long-term follow-up measurement, is needed to increase the understanding regarding long-term effects of intervention programs. Along this line, a better understanding of mediators of change is emphasized. Daily engagement in PA promotion over a prolonged period of time will also increase the sustainability of the intervention. Despite considerable efforts in increasing PA more research is needed to tackle the problems associated with insufficient PA. The comprehensive benefits of sufficient PA throughout the lifespan make efficient intervention programs a valuable investment in the health of our society.

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INTRODUCTION

Insufficient physical activity (PA) is considered an important component contributing to the high prevalence of overweight and obesity and associated co-morbidities, such as cardio-vascular disease or diabetes II [1, 2]. The World Health Organization estimates that more than 60% of the world population are at increased risk for non-communicable diseases due to physical inactivity [3]. Further, an estimated 1.9 million deaths have been attributed to a lack of sufficient PA, which makes physical inactivity the 4th leading cause of deaths worldwide [4]. Particularly, young people are believed to be insufficiently active to obtain health benefits [5] with a pronounced drop in PA occurring at the time of school entry followed by a

continued decline in PA levels throughout childhood and adolescence [6, 7]. It is, therefore, necessary to facilitate sufficient PA and support an active lifestyle as early as possible. It has also been argued that long-term behavioral patterns are established during adolescence, which underlines the importance of sufficient PA at young ages in order to increase the chances for sufficient PA throughout the entire lifespan [8]. An additional benefit of an early promotion of PA is that children generally display higher levels of PA if they are given the opportunity and are not restricted by certain rules or the environment. At younger ages it might actually be sufficient to avoid a drop in PA rather than trying to increase activity levels.

Due to the importance of PA regarding overall health

and well-being the need for effective intervention strategies to promote PA in children and adolescents has been emphasized in various policy documents [9]. Several reviews have been published on the efficacy of different PA intervention programs in youth [9-15]. As PA is a complex phenotype that is influenced by biologic and genetic constraints as well as the social and built environment, interventions can take place at different levels. In general, school-based, family- and community-based, or environmental approaches have been used. The main purpose of this review is to provide an overview of different PA promotion strategies utilized in children and adolescents. Particularly education-based programs, environmental facilitation of PA, specific activity programs, and multi-component approaches will be addressed. Rather than performing another extensive literature review on the efficacy of various intervention programs in different settings the focus is on different approaches to promote an active and healthy lifestyle in children and adolescents. A literature search has been performed in pubmed and medline. References of previous reviews on the efficacy of different PA interventions in youth have been considered as well. Even though many programs include a nutrition component in order to address an overall healthy lifestyle the focus of this review is on facilitating PA in children and adolescents.

Education-based promotion of PA

Most health intervention programs rely at least partially on education or motivation for PA. While the school is a common setting for education-based intervention programs this approach has been used in other settings as well. PACE+ for adolescents, for example, evolves around the primary care provider supported by several communication tools [16]. The one-year intervention starts with a computer-based self-assessment of the current health behavior, followed by a consultation with the primary care provider. Based on the initial results participants are given individualized behavior change plans for PA and/or nutrition. In addition, participants receive a manual to support behavioral changes. Monthly phone calls from the primary care provider and regularly mailed worksheets and tip sheets supporting a healthy lifestyle are used to support continued engagement in the intervention and allow for possible adjustments. In a randomized controlled trial involving 819 adolescents between 11 and 15 years of age a reduction in sedentary behavior was observed following the intervention. PA, however, increased only in boys [16]. A similar approach using home-based one-on-one information on PA and diet in low SES adolescents showed a reduction in BMI, which could be sustained beyond the intervention period [17]. Multilevel models with random intercepts also showed behavioural changes, but these were no longer

apparent after secession of the program.

Besides the utilization of individualized programs, there is the possibility to distribute information on an active and healthy lifestyle to a large population via the public media. Gentile et al. [18] utilized billboard advertisements and the local media in addition to school-based education on PA and diet. As reported for the individualized program, monthly information packets were sent via mail to parents and children and access to a web-based health education program (Healthy Hearts for Kids) was provided. Results of a randomized-control study involving 1,323 third-through fifth-grade students were in accordance with those reported for the individualized programs; there was a reduction in sedentary behaviour, but no change in PA [18]. These results, along with other studies using an education-only approach in various settings [19-22] suggest that PA promotion in youth, particularly in younger children, may require more than information on the benefits of PA and motivation for a more active lifestyle. There is, however, a lack of evidence on education-only PA promotion in children. An activity permissive environment, nevertheless, may be a more favourable approach to increase PA in children and adolescents.

Environmental changes to promote PA

Community-based environmental changes can either focus on facilitation of an active transport or provide safe places for PA after school. In the California Safe Routes to School Legislation program it has been shown, via a retrospective parent questionnaire, that the availability of sidewalks and safe pedestrian crossings with traffic lights along with the construction of bike lanes increased the likelihood of an active commute to school in third- through fifth-grade students [23]. Further, access to supervised playgrounds after school and during weekends has been shown to increase PA and outdoor activity [24]. The availability of space, physical structures, and playing equipment for active choices during recess has been shown to increase PA as well [25]. This randomized-controlled study further showed that elementary-school children increased their PA even though they were given the choice between places for quiet and sedentary behavior and an active engagement in PA or sports. Such results indicate the inherent drive of children for PA, which should not be hindered by a restrictive environment.

The traditional classroom in a school-setting is in general considered to be such a restrictive environment. Lanningham-Foster et al. [26], for example, examined differences in habitual PA between a regular classroom setting, a classroom with standing desks and a setting called "the neighborhood". The neighborhood resembled a small village which included activity

promoting facilities such as miniature golf, basketball hoops, indoor soccer, or climbing mazes. During lesson plans participants were allowed to move freely in this environment using portable video display units to complete their tasks. Higher accelerometer-determined PA levels were observed in the neighborhood compared to a matched control sample in 10-year-old children, while there was no difference in PA levels between standing desks and the regular classroom setting. Standing desks, however, did reduce sedentary time. Despite the positive outcomes of this intervention the authors acknowledged that such an educational environment may not be feasible on a large scale. It could, however, encourage creative ideas to foster PA during class-time and help in the development of other, more applicable classroom interventions.

Overall, only a few studies have examined the potential of environmental facilitation of PA. Therefore, only limited information on the efficacy of such interventions is available and in children and adolescents the evidence is inconclusive. Nevertheless, an activity permissive environment in schools and in the community does have the potential to increase PA and Ridgers et al. [27] argue that particularly in younger children structural, environmental or policy changes may be needed to change activity behaviours. It may, however, be necessary to ensure children and adolescents are utilising the opportunities given to them and specific activity programs may be a more direct approach in the promotion of PA in youth.

PA promotion via specific activity programs

Activity programs can be implemented within the school environment or outside school. Within the school setting, specific programs may be incorporated within PE. Currently children obtain between 9% and 24% of their PA during PE class [28] and, based on a randomized controlled trial, it has been shown that the implementation of a curriculum that emphasizes increased PA increases activity levels during PE as well as overall PA in 11- to 12-year-old students without any additional time allocated to PE classes [29]. In addition, active breaks can be implemented in the regular curriculum. The incorporation of active breaks has also been shown to positively affect attention and increase academic performance [30, 31], which could motivate teachers to utilize active breaks during their class-time. A more pronounced approach, however, is the implementation of extra PE lessons. Sollerhed and Ejlertsson [32], for example, implemented a daily 40-minute PE lesson in Swedish elementary schools. Four of those lessons were guided by the PE teacher and one consisted of outdoor activities that were supervised by the classroom teacher. A three-year longitudinal study utilizing a matched control design showed higher PA levels as well as an increase in aerobic fitness in the

intervention school. Children with daily PE also displayed a less pronounced weight gain [32]. The higher fitness levels and lower body weight may further facilitate participation in PA or sports outside the intervention due to increased self-efficacy. Nevertheless, daily PE is generally limited to special programs rather than being part of the general school curriculum.

After school programs with a mandatory PA component are another common approach to increase activity levels in youth. Several studies have shown the potential to increase PA levels by combining academic work and PA in after-school programs [33-35]. The inclusion of parents via monthly sports competitions [34] could be an additional component to promote parental engagement in PA promotion in youth, which is crucial for sustainable results. Having parents exercise together with their children for several times per week has also been used to facilitate parental involvement [36]. Both, home-based as well as center-based PA programs, were shown to increase PA and health-related fitness in adolescent girls [36]. Due to the increasing influence of peers on behavioral choices during adolescence, peer-group interventions may also help to increase PA levels in this age group. PA facilitation in scout groups, however, did not result in higher moderate-to-vigorous PA in randomized-controlled studies, but lead to a reduction in sedentary time [37, 38]. Role modelling by troop leaders, peers and parents, and positive experiences to increase self-efficacy along with positive reinforcement, on the other hand, did result in higher PA levels in 9- to 13-year-old girls [39].

Overall, it remains to be determined whether PA programs can increase total daily PA and whether higher PA levels during days with the intervention transfer to days without the intervention or into the post-intervention period. Higher fitness levels as a result of added engagement in moderate-to-vigorous PA along with positive experiences could positively affect PA levels beyond the intervention. The sustainability of activity programs could be improved by combining PA programs with educational strategies supporting behavioural change. Multi-component programs, which address the importance of PA along with an active engagement, for example, have been shown to provide greater benefits than any single component strategy [11].

Multi-component strategies to promote PA

One example of such a multi-component program, including education, PA and environmental facilitation, is MEND (Mind, Exercise, Nutrition, Do it) [40]. This program relies on educational sessions along with practical PA sessions twice a week for the entire

family. To promote PA beyond the 6 months intervention period, participants got a 12-week family swimming pass for free. A randomized control study with 116 children between 8 and 12 years of age showed beneficial effects of the intervention on cardiovascular fitness, PA, sedentary behavior, self-esteem, and BMI, which were still present 6 months after completion of the intervention.

Various after-school programs also utilize a combination of information on healthy choices and active participation in PA [41-43] and in-school educational programs have been commonly supported by providing activity time in the classroom [44-48] or increased activity time during PE [49-51]. The “Kindersportstudie” (KISS) [52, 53], for example, combined daily PE with active breaks in the classroom and promoted after-school PA via specific homework assignments including the entire family. Results of a cluster-randomized controlled trial including 498 elementary school children showed better cardiovascular fitness and lower body fat contents in the intervention group [52]. Further, parents have been included via online or mailed information [46, 47, 50, 54] to increase the transferability of in-school interventions to the out-of-school environment. Longitudinal matched control studies showed positive changes in health-behavior, including PA, as well as body composition in children and adolescents [46, 53]. A web-based interaction between 5th grade children and college students to facilitate goal setting in addition to a specific PE curriculum has also been used to re-inforce the incorporation of PA outside the intervention period [55]. In addition, specific community-based activities or information on community resources for PA outside the school setting can help to include the entire community in the intervention program [56-58]. Beneficial effects on PA in middle- and high-school students of such approaches have been shown in randomized controlled trials [56, 57], but results in children have been inconclusive [9].

Besides the combination of education and PA, there are programs that use environmental facilitation such as equipment for PE or play during recess to support education-based programs [59-61]. Consistent with previous findings of multi-component strategies, PA was higher and sedentary behavior was lower in the intervention groups in children and adolescents [58, 60]. In the diabetes prevention program walking and cycling paths were constructed in addition to a health education curriculum [62]. The community was incorporated via special events, such as cyclothons or walking clubs, as well as advertisements in the newspaper and on the radio. A longitudinal study did report some initial positive effects on health behavior and body composition in elementary school children,

but these could not be sustained throughout the 8-year study period [62]. Another comprehensive approach is the Canadian program Action Schools!BC, which addresses six components to promote PA in children and adolescents [63, 64]. These so-called action zones, which focus on the school environment, PE, classroom activity, school spirit, the family and community, and extra-curricular PA, are supposed to provide help in developing target-specific intervention strategies. Even though specific programs are based on the different needs of schools and communities all participants are required to engage in extracurricular activity for at least 15 min/day and have 2 PE lessons per week. In a 16-month cluster-randomized controlled trial in 9- to 11-year-old children, beneficial effects on PA only occurred in boys but not in girls [63]. Despite some mixed results it has been argued that multi-component approaches have a strong potential to increase PA in adolescents while the evidence in children remains inconclusive. The lack of evidence in children may partially be explained by a lower number of high quality studies in this age group. Further, van Sluijs et al. [9], argue that activity levels during adolescence are lower than during childhood, which would increase the potential for a positive change in adolescents.

Summary of Findings and Future Directions

In summary, it has been shown that PA promotion in youth has utilized a large number of different strategies. Results on the success of different interventions, however, remain equivocal, which is partially due to a difference in the quality of studies. Currently, evidence for an effect of education-based only approaches is insufficient [9]. Concerning PA programs only, it remains to be determined whether these approaches can affect behavior outside the specific intervention as well as beyond the intervention period. School-based interventions, including active participation in various activities have been shown to be effective in improving PA levels in children as well as adolescents [11, 15]. Multi-component strategies in the school setting, which include the family along with environmental facilitation, seem to be the most effective intervention strategy [9, 11]. The involvement of parents is particularly important to ensure a sustained effect as parents have a strong influence on the development of lifelong habits of their offspring [65]. In adolescents peer-group intervention could provide some additional benefits as parents become less influential on behavioral choices at this age. Regarding environmental facilitation, safe spaces for play and active transportation need to be available. Further, changes in the traditional classroom environment have been shown to increase activity levels [66].

Daily engagement with the intervention along with an

intervention period of at least one year or repeated interventions has been suggested to increase the likelihood of sustainable effects [11, 67]. As PA improvements in response to different intervention programs are generally of short duration [11] mediators of intervention effects may have to be considered more strongly as well in order to develop appropriate and successful intervention programs that will result in longterm behavior change [42]. In addition, evaluation studies should differentiate between PA during the intervention and outside the intervention setting and continue the evaluation beyond the intervention program to evaluate the transferability of immediate intervention effects into a “real-life” situation [11, 15]. Long-term follow-up measurements could also amplify potentially small changes in health behaviour or health-related outcomes, which may not be detectable in the short-term but could become valuable over time. Further, potential confounders and cluster-effects need to be considered and addressed in the analysis in order to clearly attribute observed changes to the intervention. Finally, adherence to an intervention program is crucial. Pate et al. [68] reported that only 5% of the participants attended at least half of the intervention settings. Low adherence may be one reason for the high prevalence of school-based interventions as most children can be reached regardless of their motivation to participate in the program. In case of family-based interventions in-home programs including self-monitoring may be more successful than those requiring attendance at external sites [10]. Modern information and communication technology facilitates the distribution of important messages along with reminders for certain activities directly to the target group. This could increase the efficacy of various family- or community-based interventions and may open up new possibilities in the promotion of PA in youth.

The variety of strategies utilized to increase PA in youth reflects the importance of sufficient PA in children and adolescents. As the promotion of an active lifestyle in young people is a key concept for future public health more research including long-term post-intervention follow-up is needed to increase the understanding of the effectiveness of different programs in order to reduce the burden associated with low PA. The global problem of insufficient PA requires changes in organizational structure, practice and policy as well as changes in the built environment as these changes will have a larger impact on the population compared to individual level programs [66]. The decision on specific strategies, however, needs to consider the target group as well as the community and should build upon intervention programs that have been evaluated by well designed studies. As the purpose of this paper was primarily the introduction of different

intervention strategies not all approaches introduced in this review have been evaluated at this time but when well-designed evaluation studies were available, information on the efficacy of these intervention strategies has been shown. The insights gained will hopefully provide additional information on starting the process of implementing PA promotion programs for children and adolescents at different levels to facilitate an active and healthy lifestyle in youth that can be sustained into adulthood resulting in an overall active and healthy lifestyle.

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